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PATENT COOPERATION TREATY (PCT)
TRAITÉ DE COOPÉRATION EN MATIÈRE DE BREVETS (PCT)

CERTIFIED COPY OF THE INTERNATIONAL APPLICATION AS FILED AND OF ANY CORRECTIONS THERETO

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International Application No. / Demande internationale n° PCT/IB 02 / 04833

International Filing Date / Date du dépôt international 20 NOVEMBER 2002 (20.11.02)

Geneva/Genève,
03 FEBRUARY 2004 (03.02.04)

International Bureau of the World Intellectual Property Organization (WIPO)

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J.-L. Baron
Head, PCT Receiving Office Section
Chef de la section "office récepteur du PCT"

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

PCT / IB 0 2 / 0 4 8 3 3

International Application No.

20 NOVEMBER 2002 (20. 11. 02)

International Filing Date

INTERNATIONAL BUREAU OF WIPO

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* PT0264.WO.P0

Box No. I TITLE OF INVENTION

"METHOD AND APPARATUS FOR MOLDING AND CURING A TYRE FOR VEHICLE WHEELS"

Box No. II APPLICANT ☐ This person is also inventor

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

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State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

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Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No. V DESIGNATION OF STATES *Mark the applicable check-boxes below; at least one must be marked.*

The following designations are hereby made under Rule 4.9(a):

Regional Patent

☒ **AP** **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZM Zambia, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

☒ **EA** **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT

☒ **EP** **European Patent:** AT Austria, BE Belgium, CH & LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, TR Turkey, and any other State which is a Contracting State of the European Patent Convention and of the PCT

☒ **OA** **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GQ Equatorial Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

☒ AE United Arab Emirates
☒ AG Antigua and Barbuda
☒ AL Albania
☒ AM Armenia
☒ AT Austria
☒ AU Australia
☒ AZ Azerbaijan
☒ BA Bosnia and Herzegovina
☒ BB Barbados
☒ BG Bulgaria
☒ BR Brazil
☒ BY Belarus
☒ BZ Belize
☒ CA Canada
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☒ ES Spain
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☒ GB United Kingdom
☒ GD Grenada
☒ GE Georgia
☒ GH Ghana
☒ GM Gambia
☒ HR Croatia
☒ HU Hungary
☒ ID Indonesia
☒ IL Israel
☒ IN India
☒ IS Iceland
☒ JP Japan
☒ KE Kenya
☒ KG Kyrgyzstan
☒ KP Democratic People's Republic of Korea
☒ KR Republic of Korea
☒ KZ Kazakhstan
☒ LC Saint Lucia
☒ LK Sri Lanka
☒ LR Liberia
☒ LS Lesotho
☒ LT Lithuania
☒ LU Luxembourg
☒ LV Latvia
☒ MA Morocco
☒ MD Republic of Moldova
☒ MG Madagascar
☒ MK The former Yugoslav Republic of Macedonia
☒ MN Mongolia
☒ MW Malawi
☒ MX Mexico
☒ MZ Mozambique
☒ NO Norway
☒ NZ New Zealand
☒ OM Oman
☒ PH Philippines
☒ PL Poland
☒ PT Portugal
☒ RO Romania
☒ RU Russian Federation
☒ SD Sudan
☒ SE Sweden
☒ SG Singapore
☒ SI Slovenia
☒ SK Slovakia
☒ SL Sierra Leone
☒ TJ Tajikistan
☒ TM Turkmenistan
☒ TN Tunisia
☒ TR Turkey
☒ TT Trinidad and Tobago
☒ TZ United Republic of Tanzania
☒ UA Ukraine
☒ UG Uganda
☒ US United States of America
☒ UZ Uzbekistan
☒ VN Viet Nam
☒ YU Yugoslavia
☒ ZA South Africa
☒ ZM Zambia
☒ ZW Zimbabwe

Check-boxes below reserved for designating States which have become party to the PCT after issuance of this sheet:

☐ ..... ☐ ..... ☐ .....
☐ ..... ☐ ..... ☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)*

See Notes to the request form

Sheet No. ...4...

Supplemental Box *If the Supplemental Box is not used, this sheet should not be included in the request.*

1. *If, in any of the Boxes, except Boxes Nos. VIII(i) to (v) for which a special continuation box is provided, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No...." (indicate the number of the Box) and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:*

   (i) *If more than two persons are to be indicated as applicants and/or inventors and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;*

   (ii) *If, in Box No. II or in any of the sub-boxes of Box No. III, the indication "the States indicated in the Supplemental Box" is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;*

   (iii) *If, in Box No. II or in any of the sub-boxes of Box No. III, the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;*

   (iv) *If, in addition to the agent(s) indicated in Box No. IV, there are further agents: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;*

   (v) *If, in Box No. V, the name of any State (or OAPI) is accompanied by the indication "patent of addition," or "certificate of addition," or if, in Box No. V, the name of the United States of America is accompanied by an indication "continuation" or "continuation-in-part": in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;*

   (vi) *If, in Box No. VI, there are more than five earlier applications whose priority is claimed: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI.*

2. *If, with regard to the precautionary designation statement contained in Box No. V, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded.*

Continuation of BOX No. IV

ADDITIONAL AGENTS:

Francesco BATTIPEDE, Pier Giovanni GIANNESI
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Italy

All enrolled at the Register of Italian Patent Office

Box No. VI PRIORITY CLAIM

The priority of the following earlier application(s) is hereby claimed:

Filing date of earlier application *(day/month/year)*	Number of earlier application	Where earlier application is:		
		national application: country	regional application:* regional Office	international application: receiving Office
item (1)				
item (2)				
item (3)				
item (4)				
item (5)				

☐ Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office)* identified above as:

☐ all items ☐ item (1) ☐ item (2) ☐ item (3) ☐ item (4) ☐ item (5) ☐ other, see Supplemental Box

* *Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10(b)(ii)):* ....

.....

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*

ISA / .....

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII DECLARATIONS

The following **declarations** are contained in Boxes Nos. VIII (i) to (v) *(mark the applicable check-boxes below and indicate in the right column the number of each type of declaration)*: Number of declarations

☐	Box No. VIII (i)	Declaration as to the identity of the inventor	:
☐	Box No. VIII (ii)	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	:
☐	Box No. VIII (iii)	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	:
☐	Box No. VIII (iv)	Declaration of inventorship (only for the purposes of the designation of the United States of America)	:
☐	Box No. VIII (v)	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	:

Sheet No. ...6...

Box No. IX CHECK LIST; LANGUAGE OF FILING

This international application contains:

(a) the following number of sheets in paper form:

request (including declaration sheets)	:	6
description (excluding sequence listing part)	:	13
claims	:	4
abstract	:	1
drawings	:	4
Sub-total number of sheets	:	28
sequence listing part of description *(actual number of sheets if filed in paper form, whether or not also filed in computer readable form; see (b) below)*	:	
Total number of sheets	:	28

(b) sequence listing part of description filed in computer readable form

(i) ☒ only (under Section 801(a)(i))

(ii) ☐ in addition to being filed in paper form (under Section 801(a)(ii))

Type and number of carriers (diskette, CD-ROM, CD-R or other) on which the sequence listing part is contained *(additional copies to be indicated under item 9(ii), in right column)*: .....

This international application is accompanied by the following item(s) *(mark the applicable check-boxes below and indicate in right column the number of each item)*: — Number of items

1. ☐ fee calculation sheet :
2. ☐ original separate power of attorney :
3. ☐ original general power of attorney :
4. ☐ copy of general power of attorney; reference number, if any: ..... :
5. ☐ statement explaining lack of signature :
6. ☐ priority document(s) identified in Box No. VI as item(s): ..... :
7. ☐ translation of international application into *(language)*: ..... :
8. ☐ separate indications concerning deposited microorganism or other biological material :
9. ☐ sequence listing in computer readable form (indicate also type and number of carriers (diskette, CD-ROM, CD-R or other))
   - (i) ☐ copy submitted for the purposes of international search under Rule 13*ter* only (and not as part of the international application) :
   - (ii) ☐ *(only where check-box (b)(i) or (b)(ii) is marked in left column)* additional copies including, where applicable, the copy for the purposes of international search under Rule 13*ter* :
   - (iii) ☐ together with relevant statement as to the identity of the copy or copies with the sequence listing part mentioned in left column :
10. ☐ other *(specify)*: ..... :

Figure of the drawings which should accompany the abstract: Fig.1

Language of filing of the international application: Italian

Box No. X SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

BOTTERO Carlo

For receiving Office use only

1. Date of actual receipt of the purported international application: 2 0 NOVEMBER 2002 (20. 11. 02)
2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent): ISA /
6. ☐ Transmittal of search copy delayed until search fee is paid

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

"Metodo ed apparato per stampare e vulcanizzare un pneumatico per ruote di veicoli"

La presente invenzione riguarda un metodo ed un apparato per stampare e vulcanizzare un pneumatico per ruote di veicoli.

Nel ciclo produttivo di un pneumatico è previsto che, successivamente ad un processo di confezionamento in cui vengono realizzati e/o assemblati i vari componenti del pneumatico stesso, venga attuato un processo di stampaggio e vulcanizzazione finalizzato a definire la struttura del pneumatico secondo una desiderata geometria, normalmente presentante un particolare disegno battistrada.

A tal fine, il pneumatico viene chiuso in una cavità di stampaggio definita internamente ad uno stampo di vulcanizzazione e conformata secondo la configurazione geometrica delle superfici esterne del pneumatico da ottenersi.

Un pneumatico comprende generalmente una carcassa, toricamente conformata ad anello, includente una o più tele di carcassa, armate con cordicelle di rinforzo giacenti in piani radiali, cioè contenenti l'asse di rotazione del pneumatico. Ciascuna tela di carcassa presenta le proprie estremità solidalmente associate ad almeno una struttura anulare di rinforzo metallica, usualmente nota come cerchietto, costituente il rinforzo dei talloni, cioè delle estremità radialmente interne di detto pneumatico, aventi la funzione di consentire l'assemblaggio del pneumatico con un corrispondente cerchio di montaggio. In corona a detta carcassa è posta una fascia di materiale elastomerico, denominata fascia battistrada, entro la quale viene ricavato al termine delle fasi di vulcanizzazione e di stampaggio un disegno a rilievo per il contatto con il terreno. Fra la carcassa e la fascia battistrada è situata una struttura di rinforzo, usualmente nota come struttura di cintura. Tale struttura usualmente comprende nel caso di pneumatici per vettura, almeno due strisce radialmente sovrapposte di tessuto gommato provvisto di cordicelle di rinforzo, solitamente metalliche, disposte parallele fra loro in ciascuna striscia ed incrociate con le cordicelle della striscia adiacente, di preferenza simmetricamente disposte rispetto al piano equatoriale del pneumatico.

Preferibilmente detta struttura di cintura comprende inoltre in posizione radialmente esterna, almeno sulle estremità delle sottostanti strisce, anche un terzo strato di cordicelle tessili o metalliche, disposte circonferenzialmente (a 0 gradi).

Infine nei pneumatici di tipo tubeless ovvero privi di camera d'aria, è presente uno strato radialmente interno avente caratteristiche di impermeabilità per assicurare la tenuta d'aria al pneumatico stesso, detto strato viene generalmente denominato liner.

Va qui precisato che, ai fini della presente descrizione, con il termine "materiale elastomerico", si intende una composizione comprendente almeno un polimero elastomerico ed almeno una carica rinforzante. Preferibilmente, tale composizione comprende inoltre degli additivi quali, ad esempio, agenti reticolanti e/o plastificanti. Grazie alla presenza degli agenti reticolanti, tramite riscaldamento tale materiale può essere reticolato, così da formare il manufatto finale.

Vi sono metodi di stampaggio e vulcanizzazione in cui viene predisposto all'interno dello stampo un pneumatico crudo posto su un supporto toroidale rigido. Detti metodi sono preferibilmente impiegati per pneumatici che, secondo recenti procedimenti di confezione, sono prodotti a partire da un limitato numero di semilavorati elementari alimentati su un supporto toroidale il cui profilo esterno coincide con quello della superficie radialmente interna del pneumatico che si vuole produrre. Detto supporto toroidale è movimentato, preferibilmente mediante un sistema robotizzato, tra una pluralità di stazioni in ciascuna delle quali viene eseguita, tramite sequenze automatizzate, una particolare fase di confezione del pneumatico (si veda ad esempio il documento EP 0 928 680 a nome della stessa Richiedente).

La domanda di Brevetto Europeo pubblicata al N° 0 976 533 a nome della stessa Richiedente descrive un metodo ed un apparato per stampare e vulcanizzare pneumatici per ruote di veicoli in cui un pneumatico crudo confezionato su un supporto toroidale viene chiuso in uno stampo di vulcanizzazione; successivamente vapore od altro fluido in pressione viene alimentato in almeno un'intercapedine di diffusione del fluido stesso creata tra la

superficie esterna del supporto toroidale e la superficie interna del pneumatico.

La Richiedente ha verificato che mediante un metodo del tipo sopra illustrato, al termine della fase di stampaggio e vulcanizzazione, il pneumatico ottenuto può talvolta presentare alcune imperfezioni. Questo avviene principalmente poiché il fluido di lavoro (ovvero di vulcanizzazione) viene a diretto contatto con lo strato più interno del pneumatico, mancando per i pneumatici direttamente assemblati e vulcanizzati sul medesimo supporto toroidale l'effetto della camera di vulcanizzazione. Quest'ultima, quando è presente all'interno del pneumatico crudo nello stampo di vulcanizzazione, consente un'uniforme distribuzione del materiale elastomerico contro lo stampo correggendo anche piccoli difetti lavorazione dovuti ad esempio a giunte, piccoli errori manuali o del tamburo di confezione. Si ricorda infatti che nei processi di confezionamento tradizionali, ovvero assemblando semilavorati anche di notevoli dimensioni (come ad esempio tele di carcassa, strisce di cintura, fascia battistrada) su tamburi di confezione cilindrici e conformando toroidalmente il pneumatico crudo mediante opportuni dispositivi (ad esempio meccanici o pneumatici) associati ai tamburi stessi, si ottengono al termine della lavorazione dei pneumatici crudi svincolati dal/i proprio/i tamburo/i di confezione e conformazione, che possono quindi alloggiare al proprio interno detta camera di vulcanizzazione.

In particolare, la Richiedente ha verificato durante lo stampaggio e la vulcanizzazione dei pneumatici confezionati direttamente su un supporto toroidale che, mentre il fluido di lavoro in pressione viene alimentato tra la superficie esterna del supporto toroidale e la superficie interna del pneumatico crudo, i vari componenti in materiale elastomerico ancora allo stato non vulcanizzato ovvero allo stato plastico possono disporsi in modo anomalo rispetto alle specifiche di progetto. In particolare, la tela o le tele di carcassa possono discostarsi e sfilarsi dalla loro posizione in zona tallone a causa dell'espansione a cui viene sottoposto il pneumatico dal suddetto fluido di lavoro. In tal modo il tiro della tela o delle tele di carcassa determinato dalla fase di stampaggio risulta inferiore rispetto a quanto è previsto per il pneumatico finito.

Analogamente alla tela di carcassa altri componenti del pneumatico crudo

possono scorrere tra loro a causa della pressione interna di vulcanizzazione nei primi minuti di tale processo, ovvero quando maggiori sono le caratteristiche plastiche del materiale elastomerico. Questo fenomeno viene maggiormente sentito in zona tallone, dove oltre al parziale sfilamento delle tele di carcassa si osservano fenomeni di mancanza od accumulo irregolare di materiale che generano gradini e discontinuità sul tallone medesimo.

La Richiedente ha percepito che fissando almeno parzialmente la geometria dei talloni e la superficie più interna del pneumatico, ovvero quella porzione di pneumatico a contatto con il supporto toroidale che per prima viene in contatto con il fluido di lavoro durante la vulcanizzazione, è possibile superare gli inconvenienti prima riscontrati.

Più in particolare la Richiedente ha trovato che pressando dall'esterno verso l'interno il pneumatico crudo e fornendo contestualmente calore alla superficie interna di detto pneumatico, si ottiene almeno una parziale vulcanizzazione dello strato più interno del pneumatico stesso e della zona dei talloni, in tal modo è possibile realizzare successivamente una fase di stampaggio e vulcanizzazione senza comportare disomogeneità ed irregolarità nel pneumatico finito.

Infatti il fluido di lavoro nelle condizioni di stampaggio e vulcanizzazione si trova a diretto contatto con parti del pneumatico già parzialmente vulcanizzate e presentanti quindi un comportamento del materiale non più plastico, ma quasi elastico. In tal caso si realizza un'uniformità di distribuzione contro lo stampo del materiale elastomerico appartenente agli strati più esterni del pneumatico. Inoltre la tensione della tela o delle tele di carcassa dovuta alla pressione di vulcanizzazione non provoca più alcun sfilamento delle tele ai talloni, essendo la tela o le tele divenute sostanzialmente solidali con i materiali elastomerici presenti in quest'area in seguito alla loro parziale vulcanizzazione.

Secondo un primo aspetto, l'invenzione riguarda un metodo per stampare e vulcanizzare un pneumatico per ruote di veicoli comprendente le fasi di: confezionare un pneumatico crudo su un supporto toroidale avente una superficie esterna sostanzialmente controsagomata ad una superficie interna di detto pneumatico crudo; riscaldare detto supporto toroidale per trasmettere

calore alla superficie interna del pneumatico a contatto con detto supporto toroidale; pressare detta superficie interna di detto pneumatico crudo contro detta superficie esterna di detto supporto toroidale mediante almeno un fluido di lavoro secondario in pressione; pressare una superficie esterna di detto pneumatico crudo contro le pareti di una cavità di stampaggio definita in uno stampo di vulcanizzazione, mediante un fluido di lavoro primario in pressione passante in almeno un'intercapedine di diffusione tra detta superficie esterna di detto supporto toroidale e detta superficie interna di detto pneumatico crudo; detto fluido di lavoro primario in pressione essendo riscaldato così da fornire calore a detto pneumatico crudo per causarne la vulcanizzazione.

In un secondo aspetto l'invenzione in oggetto riguarda un apparato per stampare e vulcanizzare un pneumatico per ruote di veicoli, detto apparato comprendendo: uno stampo di vulcanizzazione a tenuta stagna predisposto ad accogliere un supporto toroidale atto a supportare un pneumatico crudo all'interno di una cavità di stampaggio; almeno un dispositivo di passaggio, atto ad alimentare almeno un fluido di lavoro primario in pressione, ricavato attraverso detto supporto toroidale e sfociante sulla superficie esterna dello stesso, così da permettere il passaggio di detto fluido di lavoro primario in pressione verso la superficie interna di detto pneumatico crudo; un dispositivo di alimentazione di un fluido di lavoro secondario in pressione operativamente associato a detto stampo di vulcanizzazione per pressare dall'esterno verso l'interno detto pneumatico crudo su detta superficie esterna di detto supporto toroidale; dispositivi di riscaldamento per riscaldare detto supporto toroidale; dispositivi di riscaldamento per riscaldare detto fluido di lavoro primario per trasmettere calore a detto pneumatico crudo e causarne la vulcanizzazione.

In un terzo aspetto, l'invenzione riguarda un apparato per stampare e vulcanizzare un pneumatico per ruote di veicoli, detto apparato comprendendo: uno stampo di vulcanizzazione predisposto ad accogliere un supporto toroidale atto a supportare un pneumatico crudo all'interno di una cavità di stampaggio; almeno un dispositivo di passaggio, atto ad alimentare almeno un fluido di lavoro primario in pressione, ricavato attraverso detto supporto toroidale e sfociante sulla superficie esterna dello stesso, così da permettere il passaggio di detto

fluido di lavoro primario in pressione verso la superficie interna di detto pneumatico crudo; dispositivi di riscaldamento per riscaldare detto fluido di lavoro primario per trasmettere calore a detto pneumatico crudo e causarne la vulcanizzazione; un contenitore a tenuta stagna predisposto ad accogliere detto supporto toroidale; un dispositivo di alimentazione di un fluido di lavoro secondario in pressione operativamente associato a detto contenitore a tenuta stagna per pressare dall'esterno verso l'interno detto pneumatico crudo su detta superficie esterna di detto supporto toroidale; dispositivi di riscaldamento per riscaldare detto supporto toroidale.

Ulteriori caratteristiche e vantaggi dell'invenzione appariranno maggiormente dalla descrizione dettagliata di alcune forme di esecuzione preferite, ma non esclusive, di un metodo ed un apparato per stampare e vulcanizzare un pneumatico per ruote di veicoli secondo la presente invenzione.

Tale descrizione verrà esposta qui di seguito con riferimento agli uniti disegni, forniti a scopo solo indicativo e, pertanto non limitativo, nei quali:

La Fig. 1 illustra una vista verticale parzialmente in sezione di una forma preferita di realizzazione dell'apparato secondo l'invenzione durante una fase del metodo in oggetto.

La Fig. 2 illustra una vista verticale parzialmente in sezione di una forma preferita di realizzazione dell'apparato secondo l'invenzione durante un'ulteriore fase del metodo in oggetto.

La Fig. 3 illustra una vista verticale parzialmente in sezione di un dispositivo appartenente ad una forma di realizzazione dell'apparato secondo l'invenzione.

La Fig. 4 illustra un diagramma che mostra l'andamento della pressione nel tempo relativamente ai fluidi di lavoro impiegati per l'esecuzione del metodo in oggetto.

Con riferimento alla Fig. 1, con 101 viene indicato un apparato di stampaggio e vulcanizzazione per pneumatici di ruote di veicoli secondo una prima forma di realizzazione della presente invenzione.

L'apparato 101 comprende uno stampo di vulcanizzazione 102 operativamente associato ad un contenitore a pressione 103.

Preferibilmente, lo stampo 102 può essere composto da una semiparte inferiore 102A ed una semiparte superiore 102B, rispettivamente impegnate ad un basamento 103A e ad una porzione di chiusura 103B del contenitore 103.

Nell'esempio illustrato a titolo indicativo, ciascuna delle semiparti inferiore 102A e superiore 102B dello stampo 102 presenta una guancia, rispettivamente inferiore 130A e superiore 130B, ed una corona di settori, rispettivamente inferiore 131A e superiore 131B.

Le semiparti inferiore 102A e superiore 102B sono reciprocamente mobili tra una condizione di apertura in cui risultano reciprocamente distanziate, ed una posizione di chiusura, visibile nelle figure 1 e 2, in cui risultano reciprocamente accostate per formare una cavità di stampaggio 104 le cui pareti interne, definite dalle suddette guance e dai suddetti settori riproducono la configurazione geometrica della superficie esterna di un pneumatico da ottenersi al termine delle fasi di stampaggio e vulcanizzazione.

Più in dettaglio, le guance sono destinate a formare le superfici esterne dei fianchi opposti del pneumatico, mentre i settori sono destinati a formare la cosiddetta fascia battistrada del pneumatico stesso, creando nella stessa una serie di intagli e scanalature longitudinali e/o trasversali, opportunamente disposti secondo un desiderato "disegno battistrada".

L'apparato 101 prevede inoltre l'impiego di almeno un supporto toroidale 10 in materiale metallico o altro materiale rigido, presentante una superficie esterna che riproduce sostanzialmente la forma della superficie interna del pneumatico. Il supporto toroidale 10 è convenientemente costituito da un tamburo smontabile, vale a dire composto da segmenti circonferenziali di cui almeno alcuni mobili centripetamente per scomporre il supporto toroidale stesso e consentirne l'agevole rimozione dal pneumatico a lavorazione ultimata.

L'apparato 101 prevede inoltre almeno un condotto 110 (Fig. 2) per un fluido di lavoro primario in pressione quale vapore, azoto od altro gas sostanzialmente inerte od una miscela di questi, fluido impiegato, come sarà meglio illustrato nel seguito per stampare e vulcanizzare il pneumatico.

Nell'apparato 101 sono inoltre preferibilmente presenti dei dispositivi di riscaldamento per lo stampo 102 preferibilmente nella forma di una pluralità di

condotti 105 per il passaggio di un fluido riscaldante.

Preferibilmente, l'apparato 101 prevede anche un dispositivo a tenuta stagna idoneo a contenere il supporto toroidale 10 su cui è stato precedentemente confezionato un pneumatico crudo 50.

Come illustrato nelle figure 1 e 2, detto dispositivo a tenuta stagna può essere, in una soluzione preferita, racchiuso ed integrato all'interno di detto stampo 102, definendo una cavità a tenuta stagna all'interno dello stesso. Preferibilmente, detto stampo 102 comprende in tal caso, una pluralità di guarnizioni 106 poste in prossimità degli sfoghi preposti alla fuoriuscita del fluido di lavoro primario impiegato per la vulcanizzazione di detto pneumatico, ed almeno una guarnizione circonferenziale 107 posta sulle superfici contrapposte delle due semiparti 102A e 102B.

Detta guarnizione circonferenziale 107 può essere realizzata mediante un O-ring o preferibilmente mediante una serie di anelli metallici sovrapposti e presentanti tra le proprie superfici contrapposte un elemento di tenuta in grado di resistere alle pressioni ed alle temperature del metodo descritto nel seguito.

Un dispositivo di alimentazione di un fluido di lavoro secondario è in tale forma di realizzazione operativamente associato a detto stampo 102. Detto dispositivo comprende almeno un condotto di mandata 108 ed un condotto di scarico 109 rispettivamente per alimentare e scaricare detto fluido di lavoro secondario in pressione quale ad esempio aria, azoto od altri gas sostanzialmente inerti all'interno di detto stampo 102, per pressare dall'esterno verso l'interno, come verrà meglio descritto nel seguito, la superficie interna di detto pneumatico crudo 50 contro la superficie esterna di detto supporto toroidale 10.

In alternativa può essere previsto (Fig. 3) un dispositivo a tenuta stagna 200 esternamente allo stampo stesso. Esso avrà sostanzialmente la forma esterna dello stampo 102 illustrato nelle figure 1, 2, ma ovviamente in esso non saranno presenti né le guance 130A e 130B, né i settori 131A e 131B precedentemente illustrati, ovvero quelle parti preposte allo stampaggio del pneumatico. Più precisamente detto dispositivo 200 comprende una semiparte inferiore 202A ed una semiparte superiore 202B, rispettivamente impegnate ad

un basamento 203A e ad una porzione di chiusura 203B ed almeno una guarnizione circonferenziale 207 posta sulle superfici contrapposte delle due semiparti 202A e 202B. Detto dispositivo 200 prevede inoltre associato ad esso un dispositivo di alimentazione di un fluido di lavoro secondario comprendente almeno un condotto di mandata 208 ed un condotto di scarico 209 rispettivamente per alimentare e scaricare detto fluido di lavoro secondario in pressione quale ad esempio aria, azoto od altri gas sostanzialmente inerti all'interno di detto dispositivo 200, per pressare dall'esterno verso l'interno, come verrà meglio descritto nel seguito, la superficie interna di detto pneumatico crudo 50 contro la superficie esterna di detto supporto toroidale 10.

Facoltativamente, detto dispositivo 200 può prevedere almeno un condotto 210 per detto fluido di lavoro primario in pressione, fluido impiegato, come sarà meglio illustrato nel seguito, per riscaldare la superficie esterna di detto supporto toroidale 10.

Inoltre, in presenza di detto dispositivo 200, l'apparato 101 non necessita di uno stampo a tenuta stagna come descritto sopra in relazione alle figure 1, 2.

Il condotto 110 (o 210) è operativamente associato ad almeno un dispositivo di passaggio, mediante ad esempio un condotto di collegamento (non illustrato) ricavato lungo almeno uno dei codoli di centratura di detto supporto toroidale 10, per permettere la diffusione di detto fluido di lavoro primario in pressione all'interno di detto supporto toroidale 10.

Detto dispositivo di passaggio prevede opportune diramazioni ricavate nel supporto toroidale 10 mediante le quali detto fluido di lavoro primario giunge ad una pluralità di condotti sfocianti sulla superficie esterna del supporto toroidale stesso, opportunamente distribuiti e dimensionati sullo sviluppo circonferenziale del medesimo. Distribuzione e dimensionamento saranno tali da prevenire l'introduzione all'interno di detto supporto toroidale 10 di materiale elastomerico crudo.

Preferibilmente, un condotto 111 atto a scaricare l'eventuale condensa, è poi previsto inferiormente a detta cavità di stampaggio 104.

In accordo con il metodo secondo l'invenzione, il pneumatico crudo 50 viene disposto sul supporto toroidale 10 prima che quest'ultimo venga inserito,

unitamente al pneumatico stesso, all'interno dello stampo di vulcanizzazione 102 a tenuta stagna predisposto in condizione di apertura o di detto dispositivo 200 a tenuta stagna, qualora questo fosse disaccoppiato da detto stampo.

In particolare, l'impegno del pneumatico sul supporto toroidale 10 può essere convenientemente ottenuto confezionando il pneumatico direttamente sul supporto stesso. In questo modo il supporto toroidale 10 viene vantaggiosamente sfruttato come sagoma rigida per la deposizione dei vari componenti, quali ad esempio liner, tele di carcassa, strutture di rinforzo ai talloni, strisce di cintura, fianchi, e fascia battistrada, concorrenti nella formazione del pneumatico medesimo. Più precisamente, detti componenti del pneumatico sono preferibilmente realizzati mediante la deposizione su detto supporto toroidale 10 di semilavorati elementari quali a titolo di esempio, listini in materiale elastomerico, bandine in materiale elastomerico comprendenti al proprio interno una pluralità di cordicelle tessili o metalliche, cordicelle metalliche preferibilmente in acciaio ad alta resistenza. Ulteriori dettagli sulle modalità di deposizione dei componenti del pneumatico sul supporto toroidale 10 sono descritti, per esempio, nella domanda di Brevetto Europeo pubblicata al N° 0 929 680 a nome della stessa Richiedente.

Il funzionamento dell'apparato 101 prevede, una volta posto detto supporto toroidale 10 supportante il pneumatico crudo 50 all'interno di detto stampo 102 (o di detto dispositivo 200 a tenuta stagna), la chiusura di quest'ultimo e l'inizio delle operazioni di stampaggio e vulcanizzazione.

Più precisamente, mediante il condotto 108 (o 208) viene inviato detto fluido secondario in pressione (indicato con "b" in figura 4) in una cavità compresa tra la superficie esterna di detto pneumatico crudo 50 e la superficie interna di detto stampo 102 (o di detto dispositivo 200). In modo sostanzialmente contemporaneo, come illustrato in Fig. 4, mediante il condotto 110 (o 210) viene inviato all'interno di detto supporto toroidale 10 detto fluido di lavoro primario in pressione (indicato con "a" in figura 4) ad una pressione inferiore a quella di detto fluido di lavoro secondario. Il transitorio ha una durata compresa tra circa 30 secondi ed un minuto primo; a regime e per una durata compresa tra 30 secondi e 6 minuti primi, il differenziale di pressione è inferiore a 10 bar,

preferibilmente di circa 1-2 bar. Il fluido di lavoro primario essendo a pressione inferiore rimarrà all'interno di detto supporto toroidale 10 senza fuoriuscire dai condotti precedentemente illustrati. In tal modo in questa fase il pneumatico crudo 50 viene pressato dall'esterno verso l'interno in modo che la sua superficie interna comprendente preferibilmente il liner venga pressata contro la superficie esterna del supporto toroidale 10.

Preferibilmente detto fluido di lavoro secondario viene alimentato a temperatura ambiente, ad una pressione generalmente compresa tra 8 e 18 bar, mentre detto fluido di lavoro primario, in questa fase preferibilmente formato da vapore, viene alimentato ad una pressione inferiore ai 16 bar e ad una temperatura generalmente compresa tra circa 170°C e 210 °C.

Nell'esempio riportato in Fig. 4, il transitorio dura circa un minuto primo, la pressione a regime del fluido di lavoro secondario è di circa 16 bar e la pressione del fluido di lavoro primario è di circa 14 bar, la pressione differenziale è quindi di circa 2 bar.

Come sopra illustrato, a regime questa fase dura alcuni minuti (circa due nell'esempio illustrato in Fig. 4). Durante questo periodo di tempo il fluido di lavoro primario riscalda il supporto toroidale 10 e questo trasmette calore alla superficie interna del pneumatico, quindi alla zona talloni e preferibilmente al liner. Questo riscaldamento non vulcanizza completamente dette parti del pneumatico ma è comunque sufficiente a conferire caratteristiche di elasticità alle parti medesime. In particolare la tela o le tele di carcassa risultano ben ancorate ai talloni e la superficie interna del pneumatico, preferibilmente il liner, diviene sufficientemente elastica da sopportare senza lacerazioni le successive pressioni del processo di stampaggio e vulcanizzazione illustrato nel seguito.

Questa fase termina scaricando il fluido di lavoro secondario per mezzo del condotto 109 (o 209) di scarico, preferibilmente in un tempo inferiore ai 2 minuti primi (1 minuto nell'esempio illustrato).

Nel caso lo stampo 102 sia a tenuta stagna, comincia immediatamente una fase successiva atta a stampare ed a vulcanizzare interamente detto pneumatico (come illustrato nelle Figure 2, 4). Detta fase inizia mediante un innalzamento della pressione di detto fluido di lavoro primario ad una pressione

compresa tra 18 e 35 bar, preferibilmente a 26-28 bar, allo scopo di stampare e vulcanizzare il pneumatico con il tiro voluto sulla tela di carcassa.

In questa fase il fluido di lavoro primario comprende preferibilmente una miscela di vapore ed azoto, anche se può essere costituito dal solo vapore o da vapore miscelato aria o con altri gas sostanzialmente inerti, o da uno o più gas quali aria, azoto, ed altri gas sostanzialmente inerti.

La pressione generata da detto fluido di lavoro primario giunge ad una intercapedine di diffusione creata fra la superficie esterna del supporto toroidale 10 e la superficie interna del pneumatico da vulcanizzare.

In una soluzione realizzativa preferenziale, l'intercapedine di diffusione si crea direttamente a seguito di una dilatazione del pneumatico provocata per effetto della spinta esercitata da detto fluido di lavoro primario.

In altre parole, la pressatura del pneumatico contro le pareti della cavità di stampaggio 104 avviene in concomitanza con una dilatazione imposta al pneumatico stesso, fino a portarne la superficie esterna ad aderire completamente contro le pareti interne della cavità di stampaggio 104. Detta pressatura avviene poi contestualmente alla somministrazione di calore per determinare la reticolazione del materiale elastomerico che compone il pneumatico stesso e la conseguente definizione geometrica e strutturale di quest'ultimo. Vantaggiosamente, detto fluido di lavoro primario che determina la pressione voluta, consentendo lo stampaggio del pneumatico, fornisce anche il calore necessario alla vulcanizzazione.

Si osservi che nel metodo in oggetto, durante la suddetta dilatazione imposta a detto pneumatico per completare le operazioni di stampaggio e vulcanizzazione, la superficie interna dello stesso (preferibilmente il liner e parte dei talloni) è come già ricordato ad uno stato quasi elastico, ovvero tali parti del pneumatico risultano parzialmente vulcanizzate per quanto precedentemente illustrato.

In tal caso, la superficie interna del pneumatico si comporta come se fosse una camera di vulcanizzazione in un metodo di vulcanizzazione convenzionale, dove una camera gonfiabile agisce contro la superficie interna di un pneumatico crudo, confezionato senza l'ausilio di un supporto toroidale, per

stampare quest'ultimo contro le pareti dello stampo distribuendo in modo sostanzialmente uniforme il materiale elastomerico presente nei diversi semilavorati.

Conseguentemente, nel metodo secondo l'invenzione, pur in mancanza di una camera gonfiabile, la superficie interna del pneumatico (preferibilmente il liner) presentando già buone caratteristiche di elasticità trasmette, in modo sostanzialmente uniforme a tutto il pneumatico, la pressione del fluido di lavoro primario, comportandosi come la camera gonfiabile di un metodo tradizionale. Si ottiene quindi grazie ad uno stampaggio uniforme un pneumatico vulcanizzato che rispetta sostanzialmente le caratteristiche nominali di progetto.

Qualora detto dispositivo 200 a tenuta stagna sia previsto separato da detto stampo 102, al termine della fase di scarico di detto fluido di lavoro secondario, il pneumatico viene estratto da detto dispositivo in modo automatizzato o manuale e viene posto all'interno di uno stampo in cui continuano nel modo sostanzialmente identico a quanto prima illustrato le fasi di stampaggio e vulcanizzazione.

Si osservi che, durante la fase di pressione del pneumatico dall'esterno verso l'interno per pressare la superficie interna del pneumatico contro la superficie esterna del supporto toroidale 10, il riscaldamento di detta superficie interna del pneumatico può essere effettuato mediante l'impiego di detto fluido di lavoro primario in pressione convogliato attraverso il supporto toroidale stesso come prima illustrato, o mediante un riscaldamento del supporto toroidale indipendente dall'impiego di detto fluido di lavoro primario, realizzato ad esempio mediante l'impiego di resistenze elettriche. In quest'ultimo caso la pressione del fluido di lavoro secondario potrà anche essere di pochi bar (anche 2 o 3), purché la pressione differenziale si mantenga nel range prima indicato.

Si osservi infine che nel metodo secondo l'invenzione, detta fase di pressare la superficie interna del pneumatico crudo 50 contro detta superficie esterna del supporto toroidale 10, può essere indifferentemente precedente, successiva o preferibilmente concomitante al riscaldamento di detto supporto toroidale 10.

RIVENDICAZIONI

1. Metodo per stampare e vulcanizzare un pneumatico per ruote di veicoli comprendente le fasi di: confezionare un pneumatico crudo (50) su un supporto toroidale (10) avente una superficie esterna sostanzialmente controsagomata ad una superficie interna di detto pneumatico crudo (50); riscaldare detto supporto toroidale (10) per trasmettere calore alla superficie interna del pneumatico a contatto con detto supporto toroidale (10); pressare detta superficie interna di detto pneumatico crudo (50) contro detta superficie esterna di detto supporto toroidale (10) mediante almeno un fluido di lavoro secondario in pressione; pressare una superficie esterna di detto pneumatico crudo (50) contro le pareti di una cavità (104) di stampaggio definita in uno stampo (102) di vulcanizzazione, mediante un fluido di lavoro primario in pressione passante in almeno un'intercapedine di diffusione tra detta superficie esterna di detto supporto toroidale (10) e detta superficie interna di detto pneumatico crudo (50); detto fluido di lavoro primario in pressione essendo riscaldato così da fornire calore a detto pneumatico crudo (50) per causarne la vulcanizzazione.
2. Metodo secondo la rivendicazione 1, in cui detto riscaldamento di detto supporto toroidale (10) viene realizzato mediante resistenze elettriche.
3. Metodo secondo la rivendicazione 1, in cui detto riscaldamento di detto supporto toroidale (10) viene effettuato mediante detto fluido di lavoro primario convogliato all'interno di detto supporto toroidale (10).
4. Metodo secondo la rivendicazione 1, in cui durante la fase di pressare detta superficie interna di detto pneumatico crudo (50) contro detta superficie esterna di detto supporto toroidale (10) mediante detto fluido di lavoro secondario in pressione, la pressione di detto fluido di lavoro secondario è maggiore della pressione di detto fluido di lavoro primario.
5. Metodo secondo la rivendicazione 4, in cui la pressione di detto fluido di lavoro primario è inferiore a 16 bar.
6. Metodo secondo la rivendicazione 4 in cui la pressione di detto fluido di lavoro secondario è compresa tra 8 e 18 bar.

7. Metodo secondo la rivendicazione 1, in cui durante la fase di pressare una superficie esterna di detto pneumatico crudo (50) contro le pareti di detta cavità (104) di stampaggio, mediante detto fluido di lavoro primario, la pressione di detto fluido di lavoro primario è compresa tra 18 e 35 bar.
8. Metodo secondo la rivendicazione 1, in cui la temperatura di detto fluido di lavoro primario è compresa tra 170°C e 210°C.
9. Metodo secondo la rivendicazione 1, in cui detto fluido di lavoro primario comprende vapore ed azoto.
10. Metodo secondo la rivendicazione 1, in cui detta fase di pressare detta superficie interna di detto pneumatico crudo (50) contro detta superficie esterna di detto supporto toroidale (10) precede detta fase di riscaldare detto supporto toroidale (10) per trasmettere calore alla superficie interna di detto pneumatico a contatto con detto supporto toroidale (10).
11. Metodo secondo la rivendicazione 1, in cui detta fase di pressare detta superficie interna di detto pneumatico crudo (50) contro detta superficie esterna di detto supporto toroidale (10) è successiva a detta fase di riscaldare detto supporto toroidale (10) per trasmettere calore alla superficie interna di detto pneumatico a contatto con detto supporto toroidale (10).
12. Metodo secondo la rivendicazione 1, in cui detta fase di pressare detta superficie interna di detto pneumatico crudo (50) contro detta superficie esterna di detto supporto toroidale (10) è sostanzialmente concomitante a detta fase di riscaldare detto supporto toroidale (10) per trasmettere calore alla superficie interna di detto pneumatico a contatto con detto supporto toroidale (10).
13. Apparato per stampare e vulcanizzare un pneumatico per ruote di veicoli, detto apparato (101) comprendendo: uno stampo (102) di vulcanizzazione a tenuta stagna predisposto ad accogliere un supporto toroidale (10) atto a supportare un pneumatico crudo (50) all'interno di una cavità (104) di stampaggio; almeno un dispositivo di passaggio, atto ad alimentare almeno un fluido di lavoro primario in pressione, ricavato attraverso detto supporto toroidale (10) e sfociante sulla superficie

esterna dello stesso, così da permettere il passaggio di detto fluido di lavoro primario in pressione verso la superficie interna di detto pneumatico crudo (50); un dispositivo di alimentazione di un fluido di lavoro secondario in pressione operativamente associato a detto stampo (102) di vulcanizzazione per pressare dall'esterno verso l'interno detto pneumatico crudo (50) su detta superficie esterna di detto supporto toroidale (10); dispositivi di riscaldamento per riscaldare detto supporto toroidale (10); dispositivi di riscaldamento per riscaldare detto fluido di lavoro primario per trasmettere calore a detto pneumatico crudo (50) e causarne la vulcanizzazione.

14. Apparato secondo la rivendicazione 13, in cui detto dispositivo di alimentazione di un fluido di lavoro secondario in pressione comprende almeno un condotto di mandata (108) ed un condotto di scarico (109).

15. Apparato secondo la rivendicazione 13, in cui detto fluido di lavoro primario è preposto al riscaldamento di detto supporto toroidale (10).

16. Apparato secondo la rivendicazione 13, in cui detti dispositivi di riscaldamento di detto supporto toroidale (10) comprendono resistenze elettriche.

17. Apparato secondo la rivendicazione 13, in cui detto stampo (102) a tenuta stagna comprende una semiparte inferiore (102A) ed una semiparte superiore (102B), rispettivamente impegnate ad un basamento (103A) e ad una porzione di chiusura (103B), almeno una guarnizione circonferenziale (107) posta sulle superfici contrapposte delle due semiparti (102A, 102B) ed una pluralità di guarnizioni (106) poste in prossimità di sfoghi preposti alla fuoriuscita di detto fluido di lavoro primario.

18. Apparato per stampare e vulcanizzare un pneumatico per ruote di veicoli, detto apparato (101) comprendendo: uno stampo di vulcanizzazione predisposto ad accogliere un supporto toroidale (10) atto a supportare un pneumatico crudo (50) all'interno di una cavità di stampaggio; almeno un dispositivo di passaggio, atto ad alimentare almeno un fluido di lavoro primario in pressione, ricavato attraverso detto supporto toroidale (10) e

sfociante sulla superficie esterna dello stesso, così da permettere il passaggio di detto fluido di lavoro primario in pressione verso la superficie interna di detto pneumatico crudo (50); dispositivi di riscaldamento per riscaldare detto fluido di lavoro primario per trasmettere calore a detto pneumatico crudo (50) e causarne la vulcanizzazione; un dispositivo (200) a tenuta stagna predisposto ad accogliere detto supporto toroidale (10); un dispositivo di alimentazione di un fluido di lavoro secondario in pressione operativamente associato a detto dispositivo (200) a tenuta stagna per pressare dall'esterno verso l'interno detto pneumatico crudo (50) su detta superficie esterna di detto supporto toroidale (10); dispositivi di riscaldamento per riscaldare detto supporto toroidale (10).

19. Apparato secondo la rivendicazione 18, in cui detto dispositivo (200) a tenuta stagna comprende una semiparte inferiore (202A) ed una semiparte superiore (202B), rispettivamente impegnate ad un basamento (203A) e ad una porzione di chiusura (203B) ed almeno una guarnizione circonferenziale (207) posta sulle superfici contrapposte delle due semiparti (202A, 202B).

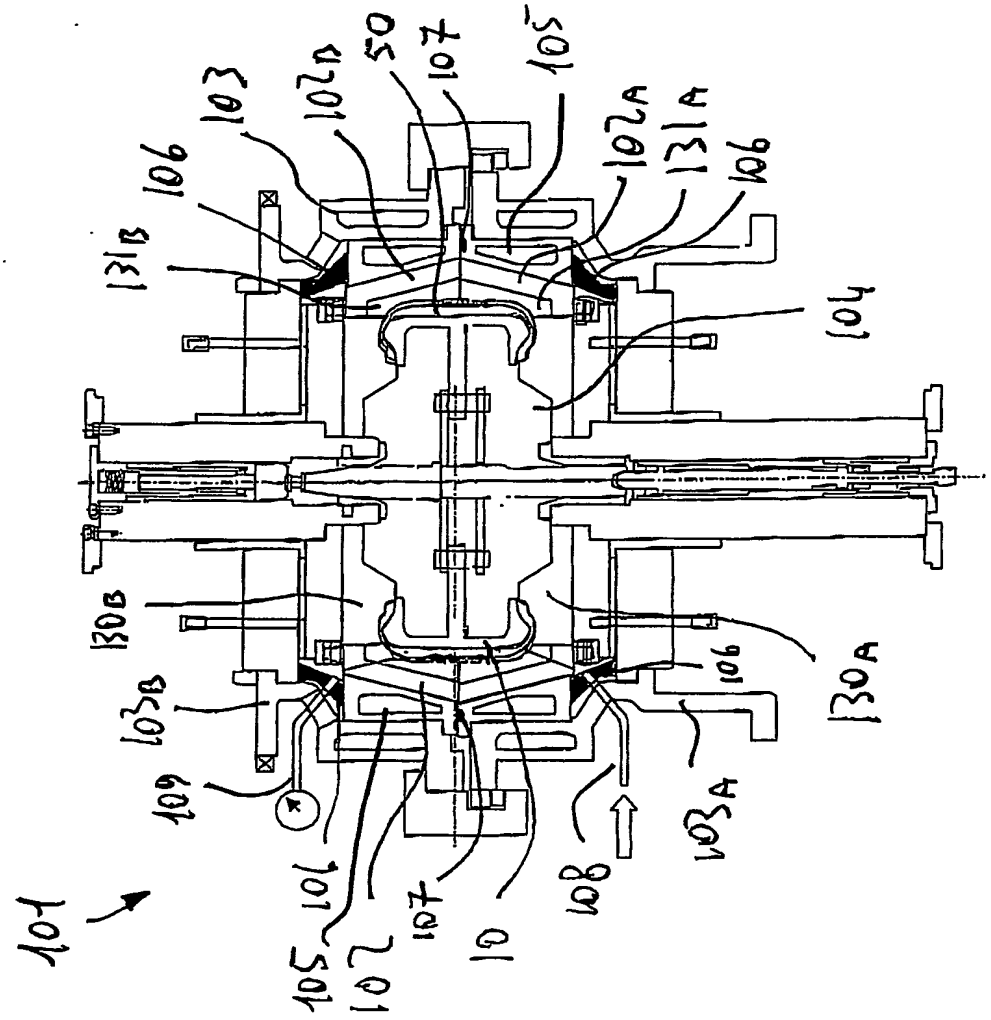
20. Apparato secondo la rivendicazione 18, in cui detto dispositivo di alimentazione di detto fluido di lavoro secondario in pressione comprende almeno un condotto di mandata (208) ed un condotto di scarico (209) rispettivamente per alimentare e scaricare detto fluido di lavoro secondario all'interno di detto dispositivo (200).

21. Apparato secondo la rivendicazione 18, in cui detto dispositivo (200) a tenuta stagna comprende almeno un condotto (210) per alimentare detto fluido di lavoro primario.

22. Apparato secondo la rivendicazione 18, in cui detti dispositivi di riscaldamento di detto supporto toroidale (10) comprendono resistenze elettriche.

RIASSUNTO

Metodo per stampare e vulcanizzare un pneumatico per ruote di veicoli comprendente le fasi di: confezionare un pneumatico crudo (50) su un supporto toroidale (10) avente una superficie esterna sostanzialmente controsagomata ad una superficie interna di detto pneumatico crudo (50); riscaldare detto supporto toroidale (10) per trasmettere calore alla superficie interna del pneumatico a contatto con detto supporto toroidale (10); pressare detta superficie interna di detto pneumatico crudo (50) contro detta superficie esterna di detto supporto toroidale (10) mediante almeno un fluido di lavoro secondario in pressione; pressare una superficie esterna di detto pneumatico crudo (50) contro le pareti di una cavità (104) di stampaggio definita in uno stampo (102) di vulcanizzazione, mediante un fluido di lavoro primario in pressione passante in almeno un'intercapedine di diffusione tra detta superficie esterna di detto supporto toroidale (10) e detta superficie interna di detto pneumatico crudo (50); detto fluido di lavoro primario in pressione essendo riscaldato così da fornire calore a detto pneumatico crudo (50) per causarne la vulcanizzazione.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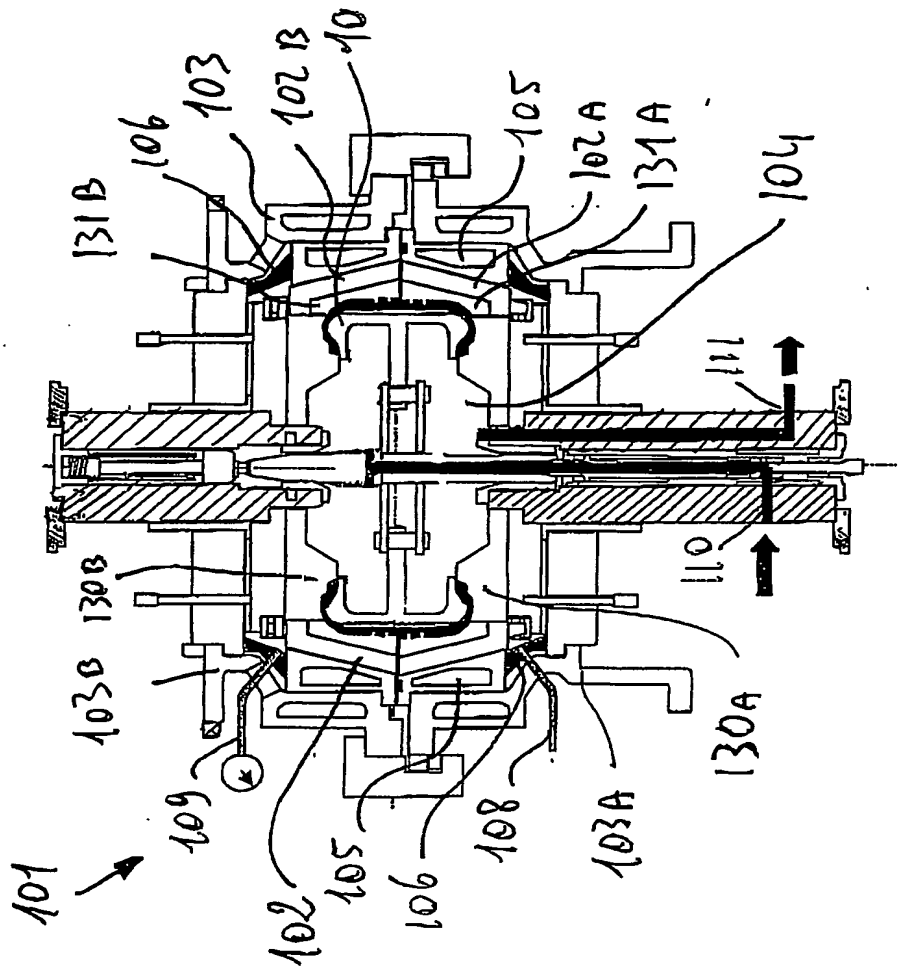
130A
103A

Fig. 1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111
110
130A

Fig. 2

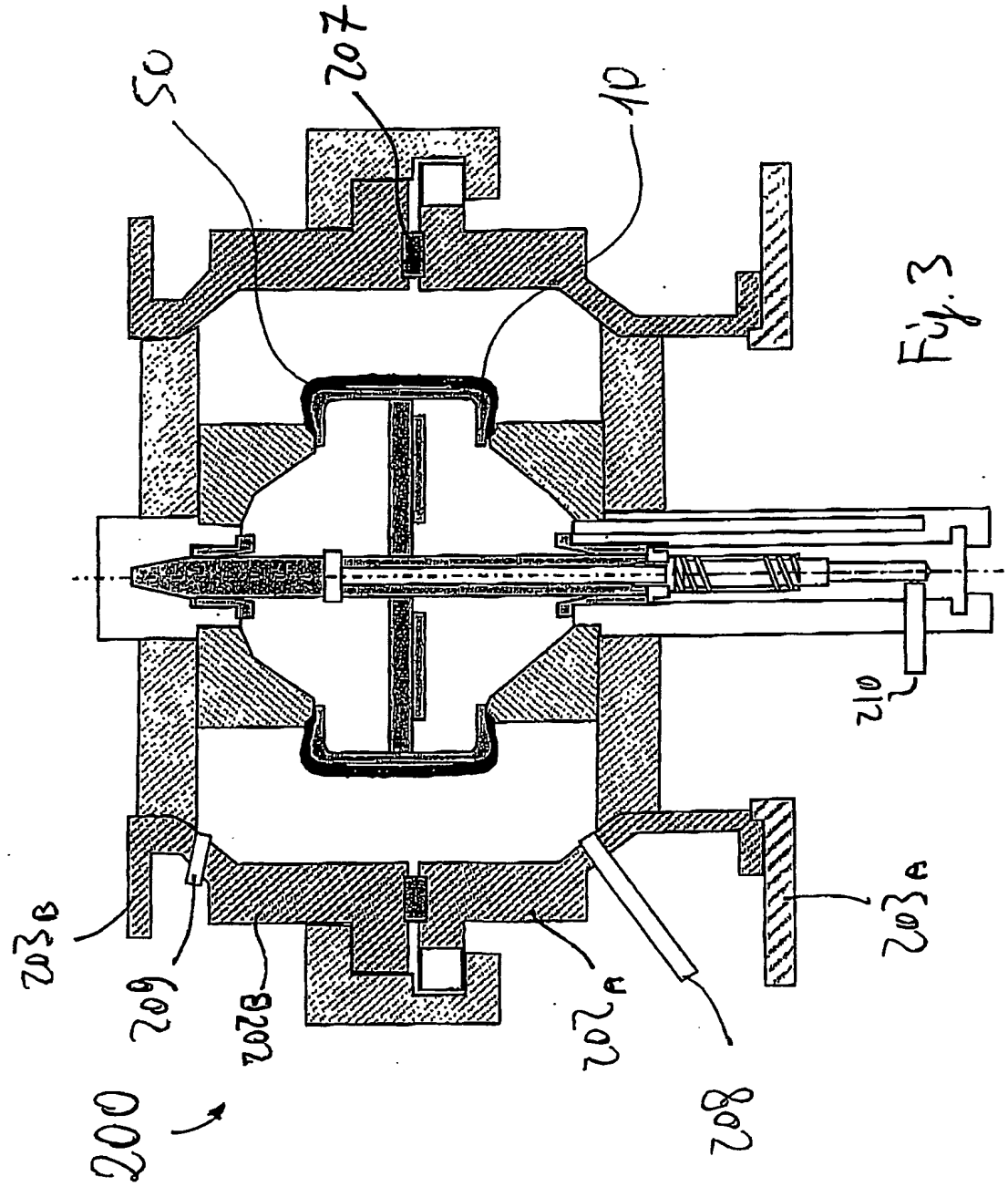

Fig. 3

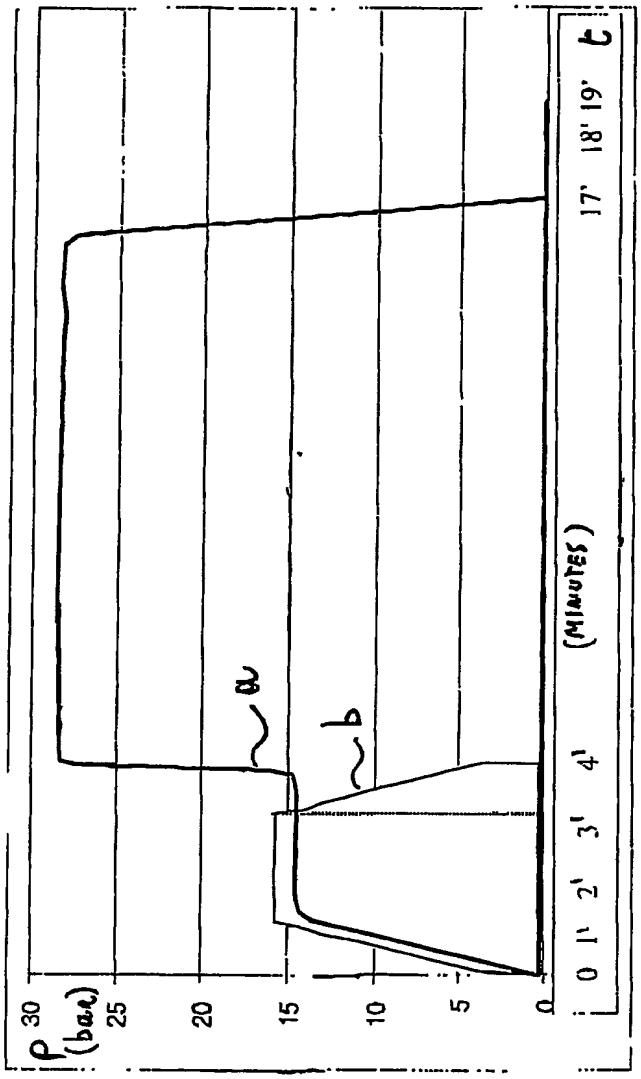

Fig. 4

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PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

PCT / IB 0 2 / 0 4 8 3 3

International Application No.

20 NOVEMBER 2002 (20. 11. 02)

International Filing Date

INTERNATIONAL BUREAU OF WIPO
PCT International Application

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* PT0264.WO.P0

Box No. I TITLE OF INVENTION

"METHOD AND APPARATUS FOR MOLDING AND CURING A TYRE FOR VEHICLE WHEELS"

Box No. II APPLICANT ☐ This person is also inventor

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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Italy

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Facsimile No. +39 02 6442 3190

Teleprinter No. 310135 PIREMI

Applicant's registration No. with the Office

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

CANTU' Marco
Via Fornace, 9
20040 Carnate (MI)
Italy

This person is:
☐ applicant only
☒ applicant and inventor
☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

BOTTERO Carlo
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Facsimile No. +39 02 6442 3190

Teleprinter No. 310135 PIREMI

Agent's registration No. with the Office

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

CONFIRMATION COPY

Sheet No. ...2...

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

CASALI Andrea
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20091 Bresso (MI)
Italy

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

MISANI Pierangelo
Via Oslavia, 30
20052 Monza (MI)
Italy

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

PIANTANIDA Pier Giuseppe
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This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

AZZARETTO Riccardo
Viale Suzzani, 269
20162 Milano
Italy

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No. V DESIGNATION OF STATES *Mark the applicable check-boxes below; at least one must be marked.*

The following designations are hereby made under Rule 4.9(a):

Regional Patent

☒ **AP** **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZM Zambia, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

☒ **EA** **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT

☒ **EP** **European Patent:** AT Austria, BE Belgium, CH & LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, TR Turkey, and any other State which is a Contracting State of the European Patent Convention and of the PCT

☒ **OA** **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GQ Equatorial Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

☒ AE United Arab Emirates	☒ GM Gambia	☒ NZ New Zealand
☒ AG Antigua and Barbuda	☒ HR Croatia	☒ OM Oman
☒ AL Albania	☒ HU Hungary	☒ PH Philippines
☒ AM Armenia	☒ ID Indonesia	☒ PL Poland
☒ AT Austria	☒ IL Israel	☒ PT Portugal
☒ AU Australia	☒ IN India	☒ RO Romania
☒ AZ Azerbaijan	☒ IS Iceland	☒ RU Russian Federation
☒ BA Bosnia and Herzegovina	☒ JP Japan	
☒ BB Barbados	☒ KE Kenya	☒ SD Sudan
☒ BG Bulgaria	☒ KG Kyrgyzstan	☒ SE Sweden
☒ BR Brazil	☒ KP Democratic People's Republic of Korea	☒ SG Singapore
☒ BY Belarus		☒ SI Slovenia
☒ BZ Belize	☒ KR Republic of Korea	☒ SK Slovakia
☒ CA Canada	☒ KZ Kazakhstan	☒ SL Sierra Leone
☒ CH & LI Switzerland and Liechtenstein	☒ LC Saint Lucia	☒ TJ Tajikistan
☒ CN China	☒ LK Sri Lanka	☒ TM Turkmenistan
☒ CO Colombia	☒ LR Liberia	☒ TN Tunisia
☒ CR Costa Rica	☒ LS Lesotho	☒ TR Turkey
☒ CU Cuba	☒ LT Lithuania	☒ TT Trinidad and Tobago
☒ CZ Czech Republic	☒ LU Luxembourg	
☒ DE Germany	☒ LV Latvia	☒ TZ United Republic of Tanzania
☒ DK Denmark	☒ MA Morocco	☒ UA Ukraine
☒ DM Dominica	☒ MD Republic of Moldova	☒ UG Uganda
☒ DZ Algeria		☒ US United States of America
☒ EC Ecuador	☒ MG Madagascar	
☒ EE Estonia	☒ MK The former Yugoslav Republic of Macedonia	☒ UZ Uzbekistan
☒ ES Spain		☒ VN Viet Nam
☒ FI Finland	☒ MN Mongolia	☒ YU Yugoslavia
☒ GB United Kingdom	☒ MW Malawi	☒ ZA South Africa
☒ GD Grenada	☒ MX Mexico	☒ ZM Zambia
☒ GE Georgia	☒ MZ Mozambique	☒ ZW Zimbabwe
☒ GH Ghana	☒ NO Norway	

Check-boxes below reserved for designating States which have become party to the PCT after issuance of this sheet:

☐ ..... ☐ ..... ☐ .....

☐ ..... ☐ ..... ☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)*

Supplemental Box *If the Supplemental Box is not used, this sheet should not be included in the request.*

1. *If, in any of the Boxes, except Boxes Nos. VIII(i) to (v) for which a special continuation box is provided, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No...." (indicate the number of the Box) and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:*

   (i) *if more than two persons are to be indicated as applicants and/or inventors and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;*

   (ii) *if, in Box No. II or in any of the sub-boxes of Box No. III, the indication "the States indicated in the Supplemental Box" is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;*

   (iii) *if, in Box No. II or in any of the sub-boxes of Box No. III, the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;*

   (iv) *if, in addition to the agent(s) indicated in Box No. IV, there are further agents: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;*

   (v) *if, in Box No. V, the name of any State (or OAPI) is accompanied by the indication "patent of addition," or "certificate of addition," or if, in Box No. V, the name of the United States of America is accompanied by an indication "continuation" or "continuation-in-part": in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;*

   (vi) *if, in Box No. VI, there are more than five earlier applications whose priority is claimed: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI.*

2. *If, with regard to the precautionary designation statement contained in Box No. V, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded.*

Continuation of BOX No. IV

ADDITIONAL AGENTS:

Francesco BATTIPEDE, Pier Giovanni GIANNESI
PIRELLI S.p.A.
Viale Sarca, 222
I-20126 MILAN
Italy

All enrolled at the Register of Italian Patent Office

Box No. VI PRIORITY CLAIM

The priority of the following earlier application(s) is hereby claimed:

Filing date of earlier application *(day/month/year)*	Number of earlier application	Where earlier application is:		
		national application: country	regional application:* regional Office	international application: receiving Office
item (1)				
item (2)				
item (3)				
item (4)				
item (5)				

☐ Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office)* identified above as:

☐ all items ☐ item (1) ☐ item (2) ☐ item (3) ☐ item (4) ☐ item (5) ☐ other, see Supplemental Box

* *Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10(b)(ii)):* ....

.....

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used)*:

ISA / .....

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII DECLARATIONS

The following **declarations** are contained in Boxes Nos. VIII (i) to (v) *(mark the applicable check-boxes below and indicate in the right column the number of each type of declaration)*: Number of declarations

☐ Box No. VIII (i)	Declaration as to the identity of the inventor	:
☐ Box No. VIII (ii)	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	:
☐ Box No. VIII (iii)	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	:
☐ Box No. VIII (iv)	Declaration of inventorship (only for the purposes of the designation of the United States of America)	:
☐ Box No. VIII (v)	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	:

Sheet No. ...6...

Box No. IX CHECK LIST; LANGUAGE OF FILING

This international application contains:

(a) the following number of sheets in paper form:

request (including declaration sheets)	:	6
description (excluding sequence listing part)	:	13
claims	:	4
abstract	:	1
drawings	:	4
Sub-total number of sheets	:	28
sequence listing part of description *(actual number of sheets if filed in paper form, whether or not also filed in computer readable form; see (b) below)*	:	
Total number of sheets	:	28

(b) sequence listing part of description filed in **computer readable form**

(i) ☐ only (under Section 801(a)(i))

(ii) ☐ in addition to being filed in paper form (under Section 801(a)(ii))

Type and number of carriers (diskette, CD-ROM, CD-R or other) on which the sequence listing part is contained *(additional copies to be indicated under item 9(ii), in right column)*: .....

This international application is accompanied by the following item(s) *(mark the applicable check-boxes below and indicate in right column the number of each item)*:

	Number of items
1. ☐ fee calculation sheet	:
2. ☐ original separate power of attorney	:
3. ☐ original general power of attorney	:
4. ☐ copy of general power of attorney; reference number, if any:	:
5. ☐ statement explaining lack of signature	:
6. ☐ priority document(s) identified in Box No. VI as item(s):	:
7. ☐ translation of international application into *(language)*:	:
8. ☐ separate indications concerning deposited microorganism or other biological material	:
9. ☐ sequence listing in computer readable form (indicate also type and number of carriers (diskette, CD-ROM, CD-R or other))	
(i) ☐ copy submitted for the purposes of international search under Rule 13*ter* only (and not as part of the international application)	:
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BOTTERO Carlo

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METHOD AND APPARATUS FOR MOLDING AND CURING A TYRE FOR VEHICLE WHEELS

Description

The present invention relates to a method and an apparatus for molding and curing a tyre for vehicle wheels.

In a tyre production cycle it is provided that following a building process in which the different tyre components are made and/or assembled, a molding and curing process is carried out which aims at defining the tyre structure in accordance with a desired geometry, usually exhibiting a particular tread pattern.

For the purpose, the tyre is closed in a molding cavity defined internally of a vulcanisation mold and shaped in accordance with the geometric configuration of the outer surfaces of the tyre to be obtained.

A tyre generally comprises a toroidally ring-shaped carcass including one or more carcass plies, strengthened with reinforcing cords lying in radial planes, i.e. containing the rotation axis of the tyre. Each carcass ply has its ends integrally associated with at least one annular reinforcing metal structure, usually known as bead core, constituting the reinforcing piece at the beads, i.e. at the radially internal ends of said tyre, the function of which is to enable assembling of the tyre with a corresponding mounting rim. Placed crownwise to said carcass is a band of elastomer material, called tread band, in which at the end of the curing and vulcanisation steps a

raised pattern is formed for ground contact. A reinforcing structure usually known as belt structure is placed between the carcass and tread band. This structure in the case of tyres for cars usually comprises at least two radially superposed strips of rubberised fabric provided with reinforcing cords, usually of metal material, disposed parallel to each other in each strip and in crossed relationship with the cords of the adjacent strip, preferably symmetrically disposed with respect to the equatorial plane of the tyre.

Preferably, said belt structure further comprises, at a radially external position thereof, at least on the ends of the underlying strips, a third layer of textile or metallic cords as well, that are disposed circumferentially (at 0 degrees).

Finally, in tyres of the tubeless type i.e. devoid of an air tube, a radially internal layer generally called liner is present which has imperviousness features to ensure the tyre air-tightness.

To the aims of the present invention it is to be pointed out that by the term "elastomer material" it is intended a composition comprising at least one elastomer polymer and at least one reinforcing filler. Preferably, this composition further comprises additives, such as cross-linking and/or plasticizing agents, for example. By virtue of the presence of the cross-linking agents, this material can be cross-linked through heating, so as to form the final manufactured article.

There are molding and curing methods in which a green

tyre put on a rigid toroidal support is arranged within the mold. Said methods are preferably employed for tyres that, following recent building processes, are produced starting from a limited number of elementary semifinished products fed onto a toroidal support the outer profile of which is coincident with that of the radially internal surface of the tyre that is wished to be produced. Said toroidal support is moved, preferably by a robotized system, between a plurality of stations in each of which, through automated sequences, a particular building step of the tyre is carried out (see document EP 0 928 680 in the name of the same Applicant, for example).

The European Patent Application published under No. 0 976 533 in the name of the same Applicant discloses a method and an apparatus for molding and curing tyres for vehicle wheels in which the green tyre built on a toroidal support is closed in a vulcanisation mold; subsequently steam or other fluid under pressure is fed into at least one gap for fluid diffusion created between the outer surface of the toroidal support and inner surface of the tyre.

The Applicant could verify that by a method of the above illustrated type, at the end of the molding and curing step, the obtained tyre may sometimes exhibit some faults. This mainly takes place because the working fluid (i.e. the vulcanisation fluid) comes directly into contact with the innermost layer of the tyre, since for tyres directly assembled and cured on the same toroidal support there is not the effect of the vulcanisation bladder. Said bladder when it is present within the green tyre in the vulcanisation mold, allows a uniform distribution of the elastomer

material against the mold also correcting small working faults due to junctions, slight manual errors or errors of the building drum, for example. In fact, it should be remembered that in traditional building processes, i.e. when semifinished products even of great sizes (such as carcass plies, belt strips, tread band, for example) are assembled on cylindrical building drums and the green tyre is shaped into a toroidal conformation by appropriate devices (mechanical or pneumatic devices, for example) associated with the drums themselves, at the end of the working operation green tyres are obtained that are disengaged from their building and shaping drum/s and can therefore internally house said vulcanisation bladder.

In particular, the Applicant could ascertain during molding and curing of the tyres directly built on a toroidal support that, while the working fluid under pressure is fed between the outer surface of the toroidal support and the inner surface of the green tyre, the various components of elastomer material still in an uncured state, i.e. in a plastic state, can take an anomalous arrangement with respect to the design specifications. In particular, the carcass ply or plies can move away from their position in the bead region and slip off due to the expansion to which the tyre is submitted by said working fluid. In this way tensioning of the carcass ply or plies determined by the molding step is lower than it is provided to be for the finished tyre.

In the same manner as the carcass ply, other components of the green tyre can slide relative to each other due to the inner vulcanisation pressure during the first minutes of this process, i.e. when the plastic features

of the elastomer material are more present. This phenomenon is more felt in the bead region, where in addition to partial slipping off of the carcass plies, phenomena of lack or accumulation of material are observed that give rise to formation of steps and discontinuities on the bead itself.

The Applicant has perceived that by at least partly fixing the geometry of the beads and the innermost surface of the tyre, i.e. that tyre portion in contact with the toroidal support that is the first to come into contact with the working fluid during vulcanisation, the above mentioned drawbacks can be overcome.

In more detail the Applicant has found that by pressing the green tyre from the outside to the inside and simultaneously supplying heat to the inner surface of said tyre, at least partial vulcanisation of the innermost layer of the tyre and of the bead region is obtained, so that a molding and curing step can be subsequently performed without involving lack of homogeneity and irregularities in the finished tyre.

In fact the working fluid under molding and curing conditions is in direct contact with parts of the tyre that have already been partly vulcanised and therefore no longer exhibit a plastic behaviour of the material but an almost elastic one. In this case it is obtained a uniform distribution against the mold of the elastomer material belonging to the outermost tyre layers. In addition tension of the carcass ply or plies due to the vulcanisation pressure does not cause any slipping off of the plies at the beads, since the ply or plies have become substantially integral with the

elastomer materials present in this region following partial vulcanisation of same.

In a first aspect, the invention relates to a method of molding and curing a tyre for vehicle wheels comprising the steps of: building a green tyre on a toroidal support having an outer surface the shape of which substantially matches that of an inner surface of said green tyre; heating said toroidal support to transmit heat to the inner surface of the tyre in contact with said toroidal support; pressing said inner surface of said green tyre against said outer surface of said toroidal support through at least one secondary working fluid under pressure; pressing an outer surface of said green tyre against the walls of a molding cavity defined in a vulcanisation mold, through a primary working fluid under pressure passing in at least one diffusion gap between said outer surface of said toroidal support and said inner surface of said green tyre; said primary working fluid under pressure being heated so as to supply heat to said green tyre to cause vulcanisation thereof.

In a second aspect the invention relates to an apparatus for molding and curing a tyre for vehicle wheels, said apparatus comprising: an airtight vulcanisation mold arranged to receive a toroidal support adapted to support a green tyre within a molding cavity; at least one passage device adapted to feed at least one primary working fluid under pressure, which is formed through said toroidal support and opens onto the outer surface of same, so as to enable passage of said primary working fluid under pressure towards the inner surface of said green tyre; a feeding device to supply a secondary working fluid under pressure

which is operatively associated with said vulcanisation mold to press said green tyre from the outside to the inside onto said outer surface of said toroidal support; heating devices to heat said toroidal support; heating devices to heat said primary working fluid to transmit heat to said green tyre and cause vulcanisation of same.

In a third aspect, the invention relates to an apparatus for molding and curing a tyre for vehicle wheels, said apparatus comprising: a vulcanisation mold arranged to receive a toroidal support adapted to support a green tyre within a molding cavity; at least one passage device, adapted to feed at least one primary working fluid under pressure, which is formed through said toroidal support and opens onto the outer surface of same, so as to enable passage of said primary working fluid under pressure to the inner surface of said green tyre; heating devices to heat said primary working fluid to transmit heat to said green tyre and cause vulcanisation of same; an airtight container arranged to receive said toroidal support; a feeding device to supply a secondary working fluid under pressure which is operatively associated with said airtight container for pressing said green tyre from the outside to the inside onto said outer surface of said toroidal support; heating devices to heat said toroidal support.

Further features and advantages of the invention will become more apparent from the detailed description of some preferred, but not exclusive, embodiments of a method and an apparatus for molding and curing a tyre for vehicle wheels in accordance with the present invention.

This description will be set out hereinafter with reference to the accompanying drawings, given by way of non-limiting example, in which:

- Fig. 1 is a vertical view partly in section of a preferred embodiment of the apparatus in accordance with the invention during a step of the method in question;
- Fig. 2 is a vertical view partly in section of a preferred embodiment of the apparatus in accordance with the invention during a further step of the method in question;
- Fig. 3 is a vertical view partly in section of a device belonging to an embodiment of the apparatus in accordance with the invention;
- Fig. 4 is a diagram showing the course of pressure over time in relation to the working fluids employed for carrying out the concerned method.

With reference to Fig. 1, a molding and curing apparatus for vehicle wheel tyres in accordance with a first embodiment of the present invention has been generally identified by reference numeral 101.

Apparatus 101 comprises a vulcanisation mold 102 operatively associated with an airtight container 103.

Preferably, the mold 102 can be made up of a lower half 102A and an upper half 102B, in engagement with a base 103A and a closing portion 103B of container 103, respectively.

In the embodiment shown by way of example, each of the lower 102A and upper 102B halves of mold 102 has a cheek, a lower cheek 130A and an upper cheek 130B

respectively, and a crown of sectors consisting of a lower sector 131A and an upper sector 131B, respectively.

The lower 102A and upper 102B halves are mutually movable between an open position at which they are spaced apart from each other, and a closed position shown in Figs. 1 and 2, at which they are close to each other to form a molding cavity 104 the inner walls of which defined by said cheeks and said sectors reproduce the geometric configuration of the outer surface of a tyre to be obtained at the end of the molding and vulcanisation steps.

In more detail, the cheeks are designed to form the outer surfaces of the opposite tyre sidewalls, whereas the sectors are designed to form the so-called tread band of the tyre itself, by creating therein a series of cuts and longitudinal and/or transverse grooves suitably disposed in accordance with a desired "tread pattern".

Apparatus 101 further contemplates use of at least one toroidal support 10 of metal or other rigid material, having an outer surface substantially reproducing the shape of the inner surface of the tyre. The toroidal support 10 is conveniently made up of a drum that can be dismantled, i.e. made up of circumferential segments at least some of which are centripetally movable to take the toroidal support to pieces and enable easy removal of same from the tyre when working is over.

Apparatus 101 further comprises at least one duct 110 (Fig. 2) for a primary working fluid under pressure such as steam, nitrogen or other substantially inert

gas or a mixture thereof, which fluid is used as better illustrated in the following, for molding and vulcanisation of the tyre.

Also preferably present in apparatus 101 are heating devices for the mold 102 preferably in the form of a plurality of ducts 105 for passage of a heating fluid.

Preferably, apparatus 101 also comprises an airtight device adapted to contain the toroidal support 10 on which a green tyre 50 has been previously built.

As shown in Figs. 1 and 2, said airtight device in a preferred embodiment can be enclosed and integrated into said mold 102, defining an airtight cavity within the same. Preferably in this case said mold 102 comprises a plurality of seals 106 disposed close to vents for escape of the primary working fluid employed for vulcanisation of said tyre, and at least one circumferential seal 107 placed on the opposite surfaces of the two halves 102A and 102B.

Said circumferential seal 107 may consist of an O-ring or preferably a series of superposed metal rings provided between their opposite surfaces, with a sealing element capable of withstanding the pressures and temperatures of the method described in the following.

A feeding device for a secondary working fluid is operatively associated, in this embodiment, with said mold 102. Said device comprises at least one delivery duct 108 and one discharge duct 109 to respectively feed and evacuate said secondary working fluid under pressure, such as air, nitrogen or other substantially

inert gases within said mold 102, to press the inner surface of said green tyre 50 from the outside to the inside, as better described in the following, against the outer surface of said toroidal support 10.

Alternatively, an airtight device 200 may be provided (Fig. 3) externally of the mold itself. Said device will substantially be of the same outer shape as mold 102 shown in Figs. 1 and 2, but obviously neither cheeks 130A and 130B nor sectors 131A and 131B illustrated above, i.e. those parts intended for tyre molding, will be present therein. More specifically, said device 200 comprises one lower half 202A and one upper half 202B, in engagement with a base 203A and a closing portion 203B respectively and at least one circumferential seal 207 put on the opposite surfaces of the two halves 202A and 202B. Also provided in said device 200 and in association therewith is a feeding device for a secondary working fluid comprising at least one delivery duct 208 and one discharge duct 209 to respectively feed and evacuate said secondary working fluid under pressure such as air, nitrogen and other substantially inert gases within said device 200, to press the inner surface of said green tyre 50 from the outside to the inside, as better described in the following, against the outer surface of said toroidal support 10.

Optionally, said device 200 may provide at least one duct 210 for said primary working fluid under pressure, which fluid is employed, as better described later on, to heat the outer surface of said toroidal support 10.

In addition, when said device 200 is present, an airtight mold as above described in connection with

Figs. 1 and 2 is not required in apparatus 101.

Duct 110 (or 210) is operatively associated with at least one passage device, through a connecting duct (not shown) for example, formed along at least one of the centering shanks of said toroidal support 10, to enable diffusion of said primary working fluid under pressure within said toroidal support 10.

Said passage device comprises suitable branches formed in the toroidal support 10, through which said primary working fluid reaches a plurality of ducts opening onto the outer surface of the toroidal support itself, conveniently distributed and sizes on the circumferential extension thereof. Distribution and sizes will be of such a nature that introduction of raw elastomer material into said toroidal support 10 is prevented.

Preferably, a duct 111 adapted to discharge possible condensate is then provided at the lower part of said molding cavity 104.

In accordance with the method of the invention, the green tyre 50 is disposed on the toroidal support 10 before the latter is inserted, together with the tyre, into the airtight vulcanisation mold 102 arranged in an open condition or into said airtight device 200 if it is de-coupled from said mold.

In particular, engagement of the tyre on the toroidal support 10 can be conveniently obtained by building the tyre directly on the support itself. In this way the toroidal support 10 is advantageously utilised as a rigid core for deposition of the different components

such as liner, carcass plies, reinforcing structures at the beads, belt strips, sidewalls and tread band that concur in tyre formation. More specifically, said tyre components are preferably obtained by deposition on said toroidal support 10 of semifinished products such as, by way of example, strips of elastomer material, strip-like elements of elastomer material internally comprising a plurality of textile or metallic cords, metal cords preferably made of high tensile steel. Further features on the procedure of laying down the tyre components onto the toroidal support 10 are described in the European Patent Application published under No. 0 929 680 in the name of the same Applicant, for example.

Operation of apparatus 101, once said toroidal support 10 carrying the green tyre 50 has been placed into said mold 102 (or said airtight device 200), involves closure of the apparatus itself and starting of the molding and curing operations.

More specifically, by duct 108 (or 208) said secondary fluid under pressure (identified with "b" in Fig. 4) is sent into a cavity included between the outer surface of said green tyre 50 and the inner surface of said mold 102 (or said device 200). Substantially simultaneously, as shown in Fig. 4, by duct 110 (or 210) said primary working fluid under pressure (identified with "a" in Fig. 4) is sent into said toroidal support 10 to a lower pressure than that of said secondary working fluid. The transient has a duration included between 30 seconds and 1 minute; in a steady-state condition and for a duration of 30 seconds to 6 minutes, the pressure differential is lower than 10 bars, preferably of about 1-2 bars. Since the

primary working fluid is of lower pressure, it will remain within said toroidal support 10 without escaping through the previously illustrated ducts. In this way during this step the green tyre 50 is pressed from the outside to the inside so that its inner surface preferably comprising the liner is pressed against the outer surface of the toroidal support 10.

Preferably said secondary working fluid is fed at room temperature, at a pressure generally included between 8 and 18 bars, while said primary working fluid, in this step preferably formed of steam, is fed to a pressure lower than 16 bars and a temperature generally included between approximately 170°C and 210°C.

In the example shown in fig. 4, the transient lasts about one minute, pressure of the secondary working fluid in a steady-state condition is about 16 bars and pressure of the primary working fluid is about 14 bars, the differential pressure therefore being about 2 bars.

As above illustrated, in a steady-state condition this step lasts some minutes (about two in the example shown in Fig. 4). During this period of time the primary working fluid heats the toroidal support 10 which transmits heat to the inner surface of the tyre, and consequently to the bead region and preferably the liner. This heating does not fully cure said parts of the tyre but at all events it is sufficient to give the parts themselves features of elasticity. In particular, the carcass ply or plies are well anchored to the beads and the inner tyre surface, preferably the liner, becomes elastic enough to withstand the subsequent pressure of the molding and vulcanisation process illustrated in the following, without tearing.

Termination of this step involves evacuation of the secondary working fluid through the discharge duct 109 (or 209), preferably in a period of time shorter than 2 minutes (1 minute in the example shown).

If mold 102 is airtight, a subsequent step immediately starts for molding and fully curing said tyre (as shown in Figs. 2, 4). Said step begins through raising of said primary-working fluid pressure to a value included between 18 and 35 bars, preferably 26-28 bars, for the purpose of molding and curing the tyre with the desired tensioning on the carcass ply.

In this step the primary working fluid preferably comprises a steam-nitrogen mixture, although it may consist of steam alone or steam admixed with air or other substantially inert gases, or one or more gases such as air, nitrogen and other substantially inert gases.

Pressure generated by said primary working fluid reaches a diffusion gap created between the outer surface of the toroidal support 10 and the inner surface of the tyre to be cured.

In a preferential embodiment, the diffusion gap is directly created following a tyre expansion caused by effect of the thrust exerted by said primary working fluid. In other words, pressing of the tyre against the walls of the molding cavity 104 takes place concurrently with an expansion imposed to the tyre itself, until bringing the outer surface thereof to fully adhere to the inner walls of the molding cavity 104. Then said pressing operation takes place simultaneously with administration of heat to produce

cross-linking of the elastomer material forming the tyre itself and consequent geometric and structural definition of the latter. Advantageously, said primary working fluid determining the desired pressure allowing the tyre to be molded, also supplies heat necessary for vulcanisation.

It will be recognised that in the concerned method, during said expansion imposed to the tyre to complete the molding and curing operations, the inner surface of same (preferably the liner and part of the beads) is in an elastic state, as already said, i.e. these tyre parts are partly cured for the above stated reasons.

In this case the inner tyre surface behaves like a vulcanisation bladder in a conventional vulcanisation method, wherein an inflatable bladder acts against the inner surface of a green tyre, manufactured without the aid of a toroidal support, for molding it against the mold walls and distribute the elastomer material present in the different semifinished products in a substantially uniform manner.

Consequently, in the method of the invention, although in the absence of an inflatable bladder, the inner tyre surface (preferably the liner) that already has good elasticity features, transmits the primary-working fluid pressure to the whole tyre in a substantially uniform manner and behaves like the inflatable bladder of a traditional method. Therefore, thanks to a uniform molding, a vulcanised tyre substantially meeting the nominal design features is obtained.

Should said airtight device 200 be provided separated from said mold 102, at the end of the step of

evacuating said secondary working fluid the tyre is extracted from said device in an automated or manual manner and is placed into a mold in which the molding and curing steps go on in a manner substantially identical with the above described one.

It is to be noted that during the tyre-pressing step from the outside to the inside in order to press the inner tyre surface against the outer surface of the toroidal support 10, heating of said inner tyre surface can be carried out by use of said primary working fluid under pressure conveyed through the toroidal support as previously illustrated, or by heating the toroidal support independently of use of said primary working fluid, by means of electric resistors, for example. In the last-mentioned case pressure of the secondary working fluid can also be of few bars (even 2 or 3), provided the differential pressure keeps within the above stated range.

It will be finally recognised that in the method of the invention said step of pressing the inner surface of the green tyre 50 against said outer surface of the toroidal support 10 can take place indifferently before, after or simultaneously with heating of said toroidal support.

C L A I M S

1. A method of molding and curing a tyre for vehicle wheels comprising the steps of: building a green tyre (50) on a toroidal support (10) having an outer surface the shape of which substantially matches that of an inner surface of said green tyre (50); heating said toroidal support (10) to transmit heat to the inner surface of the tyre in contact with said toroidal support (10); pressing said inner surface of said green tyre (50) against said outer surface of said toroidal support (10) through at least one secondary working fluid under pressure; pressing an outer surface of said green tyre (50) against the walls of a molding cavity (104) defined in a vulcanisation mold (102), through a primary working fluid under pressure passing in at least one diffusion gap between said outer surface of said toroidal support (10) and said inner surface of said green tyre (50); said primary working fluid under pressure being heated so as to supply heat to said green tyre (50) to cause vulcanisation of same.

2. A method as claimed in claim 1, wherein heating of said toroidal support (10) is carried out by means of electric resistors.

3. A method as claimed in claim 1, wherein heating of said toroidal support (10) is carried out through said primary working fluid conveyed into said toroidal support (10).

4. A method as claimed in claim 1, wherein during the step of pressing said inner surface of said green tyre (50) against said outer surface of said toroidal support (10) by said secondary working fluid under

pressure, the pressure of said secondary working fluid is greater than the pressure of said primary working fluid.

5. A method as claimed in claim 4, wherein the pressure of said primary working fluid is less than 16 bars.

6. A method as claimed in claim 4 wherein the pressure of said secondary working fluid is included between 8 and 18 bars.

7. A method as claimed in claim 1, wherein during the step of pressing an outer surface of said green tyre (50) against the walls of said molding cavity (104) by means of said primary working fluid, the pressure of said primary working fluid is included between 18 and 35 bars.

8. A method as claimed in claim 1, wherein the temperature of said primary working fluid is included between 170°C and 210°C.

9. A method as claimed in claim 1, wherein said primary working fluid comprises steam and nitrogen.

10. A method as claimed in claim 1, wherein said step of pressing said inner surface of said green tyre (50) against said outer surface of said toroidal support (10) comes before said step of heating said toroidal support (10) in order to transmit heat to the inner surface of said tyre in contact with said toroidal support (10).

11. A method as claimed in claim 1, wherein said step of pressing said inner surface of said green tyre (50)

against said outer surface of said toroidal support (10) comes after said step of heating said toroidal support (10) in order to transmit heat to the inner surface of said tyre in contact with said toroidal support (10).

12. A method as claimed in claim 1, wherein said step of pressing said inner surface of said green tyre (50) against said outer surface of said toroidal support (10) takes place substantially simultaneously with said step of heating said toroidal support (10) in order to transmit heat to the inner surface of said tyre in contact with said toroidal support (10).

13. An apparatus for molding and curing a tyre for vehicle wheels, said apparatus (101) comprising: an airtight vulcanisation mold (102) arranged to receive a toroidal support (10) adapted to support a green tyre (50) within a molding cavity (104); at least one passage device adapted to feed at least one primary working fluid under pressure, which is formed through said toroidal support (10) and opens onto the outer surface of same, so as to enable passage of said primary working fluid under pressure towards the inner surface of said green tyre (50); a feeding device to supply a secondary working fluid under pressure, which is operatively associated with said vulcanisation mold (102) to press said green tyre (50) from the outside to the inside onto said outer surface of said toroidal support (10); heating devices to heat said toroidal support (10); heating devices to heat said primary working fluid to transmit heat to said green tyre (50) and cause vulcanisation of same.

14. An apparatus as claimed in claim 13, wherein said

feeding device of a secondary working fluid under pressure comprises at least one delivery duct (108) and one discharge duct (109).

15. An apparatus as claimed in claim 13, wherein said primary working fluid is designed to heat said toroidal support (10).

16. An apparatus as claimed in claim 13, wherein said heating devices of said toroidal support (10) comprise electric resistors.

17. An apparatus as claimed in claim 13, wherein said airtight mold (102) comprises a lower half (102A) and an upper half (102B) in engagement with a base (103A) and a closing portion (103B) respectively, at least one circumferential seal (107) placed on the opposite surfaces of the two halves (102A, 102B) and a plurality of seals (106) placed close to vents intended for release of said primary working fluid.

18. An apparatus for molding and curing a tyre for vehicle wheels, said apparatus (101) comprising: a vulcanisation mold arranged to receive a toroidal support (10) adapted to support a green tyre (50) within a molding cavity; at least one passage device, adapted to feed at least one primary working fluid under pressure, which is formed through said toroidal support (10) and opens onto the outer surface of same, so as to enable passage of said primary working fluid under pressure to the inner surface of said green tyre (50); heating devices to heat said primary working fluid to transmit heat to said green tyre (50) and cause vulcanisation of same; an airtight device (200) arranged to receive said toroidal support (10); a

feeding device to supply a secondary working fluid under pressure which is operatively associated with said airtight device (200) for pressing said green tyre (50) from the outside to the inside onto said outer surface of said toroidal support (10); heating devices to heat said toroidal support (10).

19. An apparatus as claimed in claim 18, wherein said airtight device (200) comprises a lower half (202A) and an upper half (202B) in engagement with a base (203A) and a closing portion (203B) respectively, and at least one circumferential seal (207) placed on the opposite surfaces of the two halves (202A, 202B).

20. An apparatus as claimed in claim 18, wherein said feeding device of said secondary working fluid under pressure comprises at least one delivery duct (208) and one discharge duct (209) to respectively feed and evacuate said secondary working fluid within said device (200).

21. An apparatus as claimed in claim 18, wherein said airtight device (200) comprises at least one duct (210) for feeding said primary working fluid.

22. An apparatus as claimed in claim 18, wherein said heating devices of said toroidal support (10) comprise electric resistors.

A B S T R A C T

A method of molding and curing a tyre for vehicle wheels comprises the steps of: building a green tyre (50) on a toroidal support (10) having an outer surface substantially conforming in shape to the inner surface of said green tyre (50); heating said toroidal support (10) to transmit heat to the inner surface of the tyre in contact with said toroidal support (10); pressing said inner surface of said green tyre (50) against said outer surface of said toroidal support (10) by means of at least one secondary working fluid under pressure; pressing an outer surface of said green tyre (50) against the walls of a molding cavity (104) defined in a vulcanisation mold (102), by means of a primary working fluid under pressure passing in at least one diffusion gap between said outer surface of said toroidal support (10) and said inner surface of said green tyre (50); said primary working fluid under pressure being heated so as to supply heat to said green tyre (50) in order to cause vulcanisation of same.

Fig.

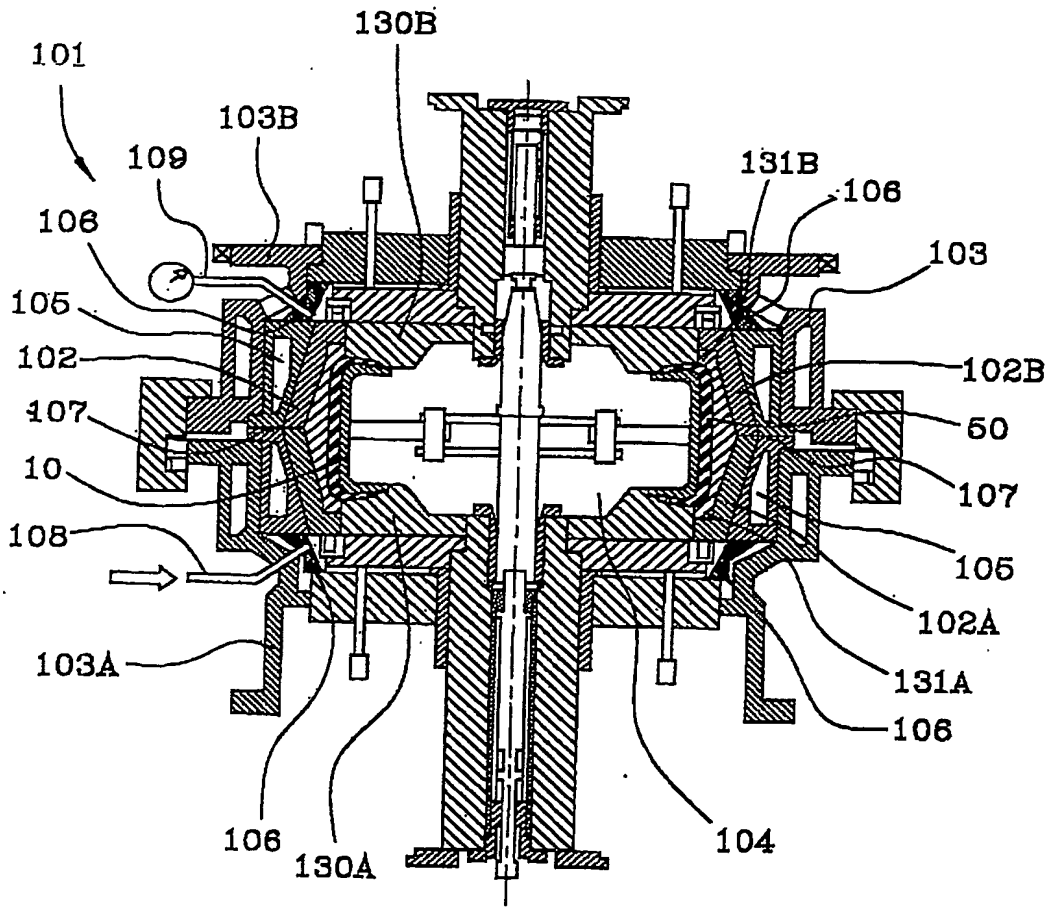
130B
101
103B
109
131B
106
106
103
105
102
102B
107
60
10
107
108
105
102A
103A
131A
106
106
130A
104

FIG 1

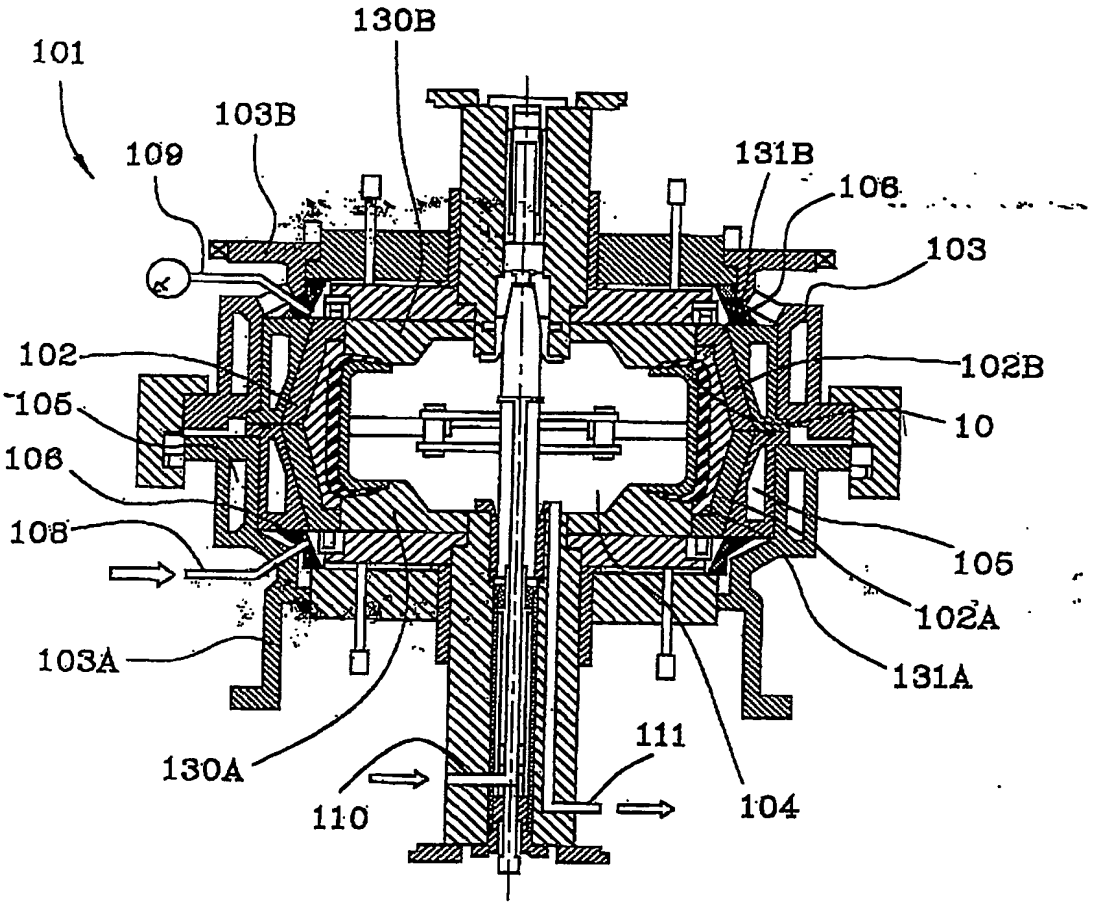
130B
101
103B
109
131B
106
103
102
102B
105
10
106
108
105
102A
103A
131A
111
130A
110
104

FIG 2

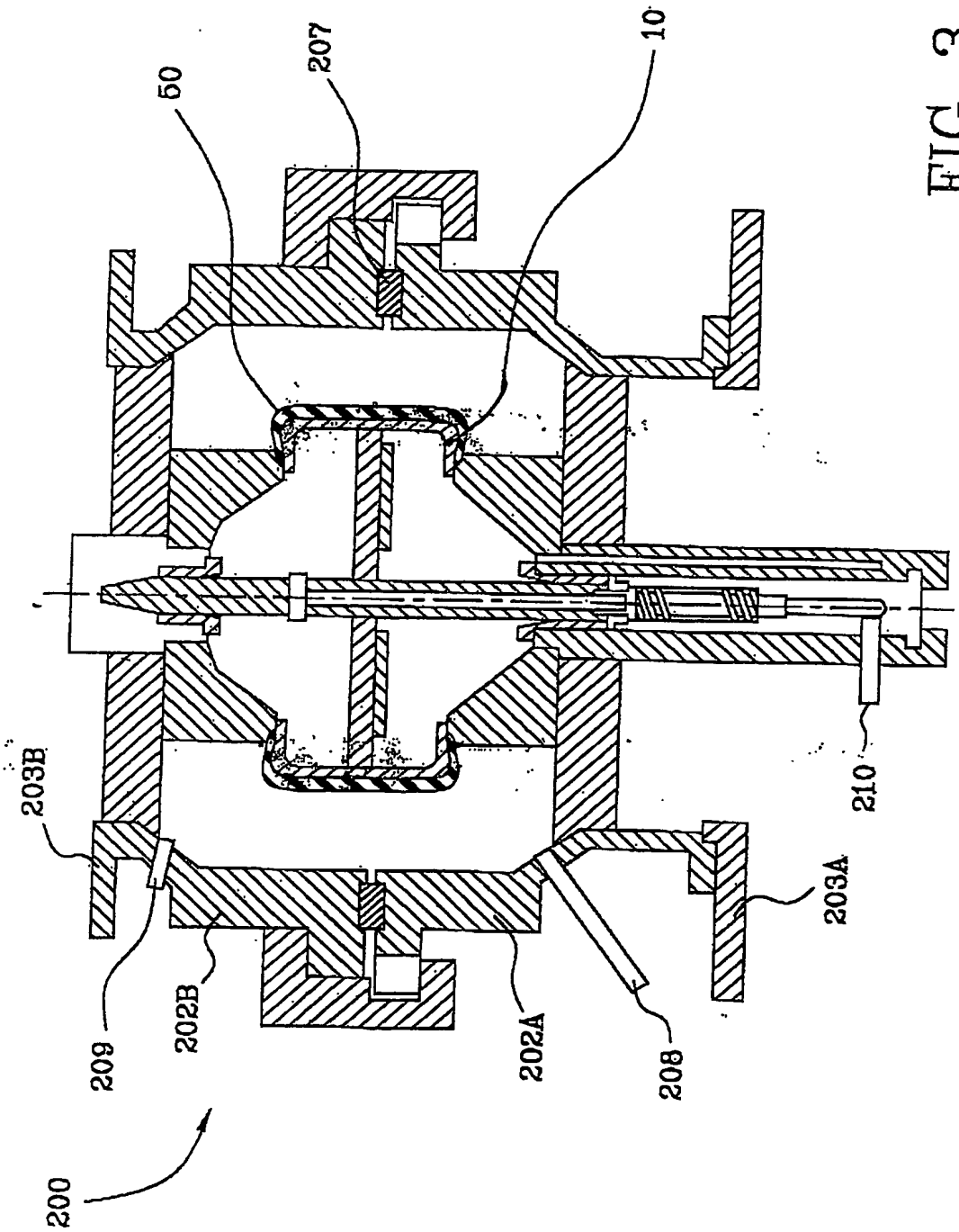

FIG 3

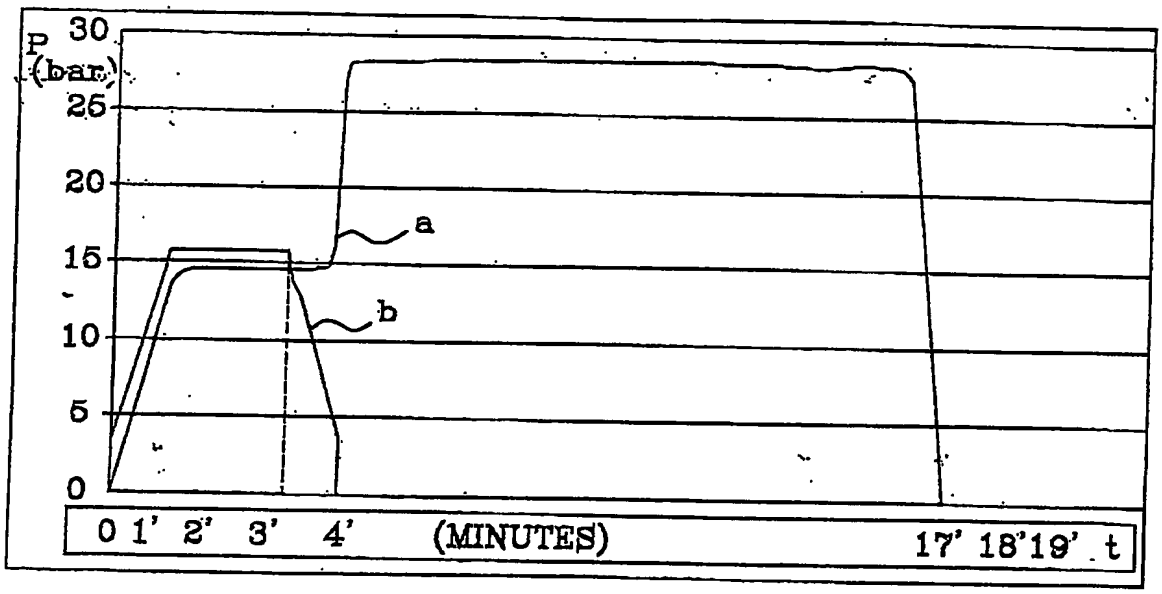

FIG 4

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